Predicting Change in Activities of Daily Living: A Longitudinal Study of the Oldest Old in Sweden

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We examined predictors of stability and decline in activities of daily living (ADLs) and mobility in a population-based sample of the oldest old. Respondents were people aged 84 to 90 living in South Central Sweden. Predictors were drawn from three domains: sociodemographic variables, vitality, and physical and psychological health. Using a logistic regression model, we sought to identify variables that were associated with changes in functioning. Over the 2-year interval, we found significant main effects for stability in ADL functioning for three variables: residential status (e.g., living in the community), subjective health, and mastery (n = 142). For mobility, we identified three variables associated with stability: lung function, subjective health, and mastery (n = 137). Over the 4-year period we found that residential status was significantly associated with stability in ADL performance (n = 89), while age, marital status, grip strength, and mastery were significant predictors for stability in mobility (n = 90). The findings can direct researchers toward interventions within particular residential environments that maintain a sense of mastery and an individual’s aggressive attitude toward challenging situations.

In their influential article, Rowe and Kahn (1987) emphasize the substantial heterogeneity in aging that had been ignored or attributed to genetic endowments alone. The authors highlight the need for interdisciplinary studies that address successful aging and the varied trajectories of function with advancing age. Several large-scale studies have taken detailed glimpses into the lives of older adults (Berkman et al., 1993; Busse & Maddox, 1985; Schaie, 1983; Shock, 1984). These research studies have identified influences on successful aging for people aged 65–79, and now the direction is toward research that examines the transitions and trajectories of the fastest growing age segment, those beyond age 80 years (Zarit, Johansson, & Berg, 1993). For a growing number of individuals, this is a period when they develop dependence on others, where disabilities can no longer be effectively managed, or when they request more health and social resources (Schneider & Guralnik, 1990; Thorslund, Norstrom, & Weinberg, 1991).

In this context it becomes important to identify factors that promote independence and delay disability in very late life. By disability, we refer to an individual’s ability to perform activities of daily living (ADLs) as a reflection of the relationship between personal resources and environmental demands. Consider the scenario where by an individual’s personal resources decline with age while his/her environmental demands increase. At first, the individual’s existing personal resources may be optimized through compensation; this is Baltes’ theory of selective optimization with compensation (Baltes & Baltes, 1990). However, at some turning point, compensation can no longer occur, and disability ensues. Verbrugge and Jette (1994) have offered a model of disability known as the disablement process. Their model describes disability as a gap between personal and environmental factors rather than as a personal characteristic. Under their paradigm a person is described as disabled if environmental demands exceed his or her personal capabilities. This conceptualization is not unlike life-span theories that characterize development as an interaction between social structures and personal aspects of the person that result in individual behavior (Baltes & Danisch, 1980). More importantly, the disablement model acknowledges that subjective feelings and psychological characteristics can influence disability as much as morbid states and environmental conditions. Therefore, understanding the nature of disability must involve the measurement of physical abilities as well as psychological constructs. The challenge is to determine how the various components are linked to each other and to the overriding construct of disability.

In this study we examine changes in disability in the oldest old and investigate the roles of demographic, psychological, and physical health variables in stability or decline in ADL functioning. We examine these issues in a unique population-based sample of individuals over the age of 84 living in Sweden. First, we wanted to answer the question of whether the group over age 84 was heterogeneous with respect to ADL functioning. Second, we wanted to examine the factors associated with stability in ADL functioning and mobility over a 2-year and a 4-year period. Using Baltes and Baltes’ (1990) concept of selective optimization with compensation as a broad framework, we were particularly interested in looking at whether the psychological variables, notably mastery, were significantly associated with changes in levels of activity over both a relatively short term (2 years) and a long (4-year) term.

Heterogeneity in Functional Performance Among the Oldest Old

One of the most common ways of measuring disability is by assessing functional ability using Katz’s (1983) self-report measure of ADL. The concept of ADL assumes a
Identifying the Correlates of Stability and Decline

The first domain from which we draw correlates of stability and decline is demographic characteristics. Patterns of disability in the oldest old may vary by certain demographic characteristics. Compared to the young-old group, the oldest old differ in their living arrangements, marital status, gender, and level of education (Longino, 1988). Nearly one-third of the oldest old did not complete middle school, and only a minority completed high school (Bould, Sanborn, & Reif, 1989). The oldest cohorts have also been less exposed to welfare programs and health systems and may not be sophisticated users of social and medical services. While this is especially true in the United States, it may be less applicable in Sweden, where old age care is freely accessible to anyone who resides in the country. In both countries, however, the oldest old may have fewer overall resources (e.g., education, informal support, etc.) that affect their risk for disability. This idea implies that changes in ADL performance are influenced by accumulated learning experiences as well as historical and cultural events.

The second domain that we draw from is the measures of biomedical vitality. Older adults experience reductions in organ resilience that affect the performance of everyday tasks, mobility, and finer motor functioning. Often stemming from disease or injury, reduced vitality may have consequences for physical, mental, and social functioning (Verbrugge & Jette, 1994). Our study uses four common measures of vitality: blood pressure, lung function, pulse, and grip strength. Lung function and grip strength are associated with linear declines with aging, although there is great heterogeneity across individuals. Blood pressure and pulse exhibit a nonlinear relationship whereby very high and very low measurements are more problematic for health. We want to know if these biomedical indicators are predictive of changes in functional performance and mobility.

The third domain involves three psychological correlates of functioning as predictors of stability. In contrast to physiological processes that universally decline with age and disease, the psychological correlates do not necessarily decline in the same magnitude or degree (Labouvie-Vief & Hakim-Larson, 1989). In fact, they often exhibit surprising stability or even gains in functioning over time (Baltes & Baltes, 1990); as a consequence, these domains may effectively close the gap between personal capability and environmental demands. For example, a person with debilitating disease but with a strong sense of mastery may not allow the disease to spiral into disability. Conversely, an individual with mild injury but who is depressed may be headed toward severe disability. It is conjectured that the latter scenario is one potential cause of “excess disability,” a phenomenon that often occurs in nursing homes because the environment positively reinforces dependence and disability (Lichtenberg, 1990).

Our study uses three psychological correlates. The first is subjective health, which has been shown to be a sensitive indicator of physiologic homeostasis, reflecting a poor emotional state that suppresses the immune system, health behavior, and ultimately, objective health. Subjective health has also been shown to affect functional ability in daily life (Idler & Kasl, 1995). The second correlate is depression, which has a well-researched relationship to physical functioning (Camacho, Strawbridge, Cohen, & Kaplan, 1993; Turner & Noh, 1988). Depressive symptoms are known to be high among individuals who may soon experience the onset of disability (Bruce, Seeman, Merrill, & Blazer, 1994). Once physical disability is present, depression and disability feed on each other, resulting in spiraling declines in both physical performance and psychological health. The third psychological correlate is mastery. This construct comes from the work of Pearlin and Schooler (1978), who first defined mastery in their work on the structure of coping. Mastery, a construct similar to control, protects individuals from life strains and stressors. The previous work on mastery suggests that people with high levels of mastery employ cognitive strategies and physical behaviors that modify the meaning and consequence of experience. Rodin (1990) also discusses mastery as a possible mechanism for successful adaptation to challenges over the entire life span. Individuals possess beliefs about whether they can cause events to occur by organizing the necessary resources or...
employing the appropriate behaviors, especially when confronted with a challenging situation.

Mastery is an especially intriguing construct in this study because of its possible contribution to the process of "selective optimization with compensation" (Baltes & Baltes, 1990). Tobin (1991) theorizes that assertiveness (e.g., high mastery) or even combativeness can offset or compensate for the developmental trajectories of physical loss and increased passivity that can lead to decline. This idea was examined within the context of the stress of relocation. Tobin proposed that those who are able to transform the situation and, thus, perceive themselves as having mastery and control over the relocation situation are more likely to have favorable outcomes to the stress. This process of mastery can involve both a defiance against lethal passivity and a cognitive illusion of mastery whereby individuals possess an overinflated sense of mastery that confronts the stress by attributing real or unreal causes to it. In either case, mastery serves as a stress management measure through personal behavior and/or health promoting attitudes.

Several studies have proposed that mastery and related constructs of control are associated with better functioning or improved outcomes in later life. Roberts and her colleagues (Roberts, Dunkle, & Haug, 1994) found the personal resources of mastery to buffer the effects of stress by providing a context for the evaluation of stress and the effectiveness of resources to meet the challenges of life. The authors considered mastery as a potential moderator of life events such that the depletion or deterioration of these resources may interfere with the tasks of daily living. These resources are especially salient for the very old, who experience the greatest declines in health and vitality.

METHODS

Sample

The sample is drawn from the OCTO project, a longitudinal panel of the oldest old. The sample was recruited in the municipality of Jönköping located in South Central Sweden. This municipality consists of the city of Jönköping and surrounding towns and rural areas, with a total population of approximately 110,000 inhabitants. A stratified random sample was drawn from census data, consisting of four groups of 100 persons each with the following birth years: 1897, 1899, 1901, and 1903. All residents with those birth years were potential subjects, including those living in sheltered housing (e.g., service apartments), in nursing homes, or other institutional settings. Subjects were initially examined in 1987 and 1988 when they were 84, 86, 88, and 90 years of age. Following a cohort sequential design, subjects were reinterviewed after 2, 4, and 6 years. In the present study, however, we restricted our analyses to the first three waves of data collection. Thus, the subjects' ages ranged between 88 and 94 years for survivors at the time of the 4-year interview.

Of the original 400 subjects identified from census data, 324 subjects were interviewed at Wave 1. The 76 individuals not interviewed included 21 subjects who died before the interview could be conducted, 1 subject who had moved out of the area, and 54 who refused to participate. Excluding subjects who were deceased or moved out of the area, the overall rate of participation was 86%.

For the present study, participants with dementia were excluded because they were expected to decline in functional abilities as part of the disease process. Diagnosis of dementia was made according to DSMIII-R criteria (American Psychiatric Association, 1987) by two independent raters who reviewed interview data including results of cognitive tests. Interrater agreement was 93.8% (kappa = .88; for more information refer to Johansson & Zarit, 1995). Using these criteria, a total of 97 (33%) participants at Wave 1 were found to have dementia. The prevalence of dementia is consistent with findings from other population-based samples of this age group (Fratiglioni et al., 1991; Skoog, Nilsson, Palmertz, Andreasson, & Svanborg, 1993). Of the remaining 227 people, 46 (20%) died before Wave 2; 11 (5%) refused or were unable to complete the second interview, and 19 (8%) had too much missing data on the measures due to extreme frailty. We also found a small number of respondents (n = 4) who had poor ADL and mobility performance (scores of 8 or lower) at both times of measurement. We excluded these cases from the analyses, because their apparent stability on the ADL and mobility measures had as much to do with a floor effect on the measures than with actual stability. The final sample size for the Wave 1 to Wave 2 analysis was 147 respondents. In subsequent analyses, the sample sizes do vary somewhat since some individuals were too frail to complete portions of the interview relevant to the analyses.

By the 4-year assessment (Wave 3), 96 respondents (44%) were deceased, and 18 subjects (8%) refused to participate at either Wave 2 or Wave 3, or were unable to complete the third interview. Of the remaining 104 (48%) respondents who survived to Wave 3, some individuals were too frail to complete significant portions of the interview, and so sufficient data were available on 89 individuals for the ADL analysis and 90 people for the mobility analysis.

Procedures and Measures

At each assessment period, interviews were conducted by a licensed nurse in the subject's place of residence. Interviews took 3.5 hours on average. They consisted of a comprehensive biomedical and behavioral assessment, including tests of cognitive functioning, self-report inventories, and ADL scales. In addition, demographic and socioeconomic information was also obtained. Finally, measures were taken of blood pressure, pulse, grip strength, lung capacity, vision, and hearing.

The outcome measure for this study was self-reported physical disability as assessed by the subjects' difficulty in performing ADLs and mobility. The measures were assessed at each time of measurement. ADLs were evaluated along two dimensions: ADL and instrumental ADL (IADLs). Mobility was measured using commonly asked mobility items. All of the items were drawn from widely used standardized assessments of these abilities (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton, 1971).

ADLs. — Subjects rated themselves on eight items drawn from Lawton's (1971) ADL scale: getting out of bed;
taking a bath or shower; washing one's self; grooming; dressing; getting to the toilet; caring for oneself when using the toilet; and eating. Subjects were asked about the amount of difficulty they had in performing the task by themselves without assistance. Each item was scored on a 4-point Likert scale ranging from no difficulty in performing the activity (a score of 3), some difficulty, great difficulty, and not being able to perform the activity at all (a score of 0). Internal reliability for the ADL scale was high (alpha = .95).

**IADLs.** — Subjects rated themselves on eight items drawn from the IADL scale: heavy household work; laundry; making the bed; cooking; grocery shopping; lifting or moving items; banking and post office (in Sweden many banking functions are carried out at the post office); and using the telephone. Each item was rated exactly as the ADLs. Internal reliability for the IADL subscales was also high (alpha = .92). Subjects who indicated that they did not do one or more of these activities were asked whether they would have difficulty with the activity if they had to perform it. For example, several men in the sample reported that they never did any housework or cooking. In these cases, the interviewers were instructed to ask the respondent whether he or she would have difficulty in performing the activity if forced to do it.

For subsequent analyses we combined the ADL and IADL subscales into our version of a summary ADL measure that we label from now on as t-ADL. We took this strategy for two reasons: first, the IADL and ADL items had high inter-item correlations. Additionally, when subjected to a principal components analysis, the items showed a hierarchical structure whereby IADLs are the more complex activities and so tend to be lost before the ADLs. The internal reliability for the combined scale was very high (alpha = .95).

**Mobility.** — Participants rated themselves on their ability to perform eight mobility functions: getting around indoors; getting around outdoors; going up stairs; bending over; raising their hands above the shoulders; getting in and out of bed; transferring from bed to chair; and picking up small items. Each item was rated similar to ADLs. Internal reliability for the mobility scale was high (alpha = .85).

The predictor variables for the analysis were chosen based on their theorized relation to functional ability and mobility. These variables were drawn from three general domains: sociodemographic characteristics, biomedical measures of vitality, and psychological measures.

**Sociodemographic characteristics.** — From the information obtained at baseline, we selected the following variables for their possible relation to stability: age, gender, marital status, education, and residential status. We treated marital status as a dichotomous variable: (1) currently married at Time 1, and (2) not married. The not-married group includes separated, widowed, and divorced individuals, as well as those who never married. A dichotomy was used because of the relatively small numbers in all these categories (except widowed). For residential status, all but one participant lived either in ordinary housing or service apartments, facilities where residents have their own apartments but are provided congregate meals, housekeeping, and other services as needed. The additional person resided in a nursing home. We decided to treat residential status as a dichotomous variable: ordinary housing or sheltered living.

**Biomedical measures of vitality.** — Four measures of vitality were used in the analyses. These included (1) sitting systolic and diastolic pressure as measured by a sphygmomanometer, (2) pulmonary function assessed by peak expiratory flow rate (liters/minute), (3) grip strength as measured by a vigorimeter (kPa), and (4) pulse rate per minute.

Of these four vitality measures, we examined the possibility that blood pressure and pulse had curvilinear relationships with stability and decline. That is, very high and very low blood pressure and pulse indicate poorer functioning than middle levels. If this were the case, then we would have to transform the variables to capture the correct nonlinear relationship. We plotted the relationship between blood pressure and pulse to stability in t-ADLs and mobility and discovered that neither of these two vitality variables had a curvilinear relationship with stability. Consequently, we decided to enter these variables in the analysis as their raw scores rather than as transformed variables.

Three psychological measures with theoretical links to stability or decline were (1) mastery, (2) subjective health, and (3) depression.

**Mastery.** — Baseline mastery was assessed with a Swedish translation of the Pearlin Mastery Scale (Pearlin & Schooler, 1978). The measure consisted of eight items that rated the extent to which people believed their lives to be under their own control. The items are rated on a 5-point Likert scale according to how strongly the respondent agrees or disagrees with a statement. A total score is determined by summing the items. For the present study we report the mean response per item. Higher scores indicate higher mastery. The alpha for the measure was .66, which is slightly lower than reported for English-language versions of the scale (e.g., Turner & Noh, 1988).

**Subjective health.** — Subjective health was assessed with a single global rating. Respondents were asked to rate their health on a 7-point Likert scale (excellent, very good, good, fair, poor, very poor, or bad). The specific wording in Swedish formed an ordinal scale with gradations clearly ranked from best to worst.

**Depression.** — Depression was measured with a short form of the Center for Epidemiological Studies Depression Scale (CES-D; Kohout, Berkman, Evans, & Cornoni-Huntley, 1993; Radloff, 1977). The short form consists of 11 items that are designed to measure an individual's current level of depressive symptomatology. Respondents are asked about the frequency with which they experienced each of 11 symptoms and problems during the past week. The items are rated on a 4-point scale, ranging from "rarely or none of the time" to "most or all of the time." A total
depression score is calculated by summing the items. In the present investigation the CES-D has been reverse-scored so that higher scores indicate lower depression.

Analyses
Analyses were performed in two steps. First, we examined the transition from baseline to 2 years (Wave 1 to Wave 2), and next we examined the transition from baseline to 4 years (Wave 1 to Wave 3). In each analysis we employed a similar strategy, starting with describing the sociodemographic characteristics of the sample, followed by examining the correlations among the predictors at baseline, and then performing a series of longitudinal analyses assessing stability and decline using logistic regression and the Wave 1 predictors. We employed this strategy of performing two separate logistic regressions to maximize the number of subjects available at each time of measurement. Because of the high mortality rate in this age group, analyses involving all three times of measurement would have a greatly reduced sample size.

RESULTS

Two-Year Transition
The sample of 147 subjects is described in Table 1. The average age was 87 years. Consistent with the greater longevity of women, the majority were women. About one-quarter of the sample was married at the initial time of measurement. The average level of education was 6.5 years, which is typical of the base education available to this age cohort of Swedes. Most of the sample resided in ordinary community housing, while the remaining noncommunity-dwelling respondents lived in service apartments, facilities where people have their own flats, but where meals, housekeeping, and other services are available on the premises. A comparison of the surviving sample of 147 with the 46 respondents who died before the second wave revealed that survivors included more women, but otherwise did not differ on any of the demographic variables.

Mean levels of the independent variables at Wave 1 and Wave 2 are shown in Table 2. Turning first to the psychological measures, the average mastery score indicated that subjects felt somewhat able to solve the problems they had. The average depression score indicated that subjects were mostly not depressed. Finally, the average subjective health score indicated that subjects felt good to very good about their health at that time. Over the 2-year period there was little variation among these measures (Table 2).

Turning now to t-ADL and mobility performance, we note that the average t-ADL score at Wave 1 was 34.4 (Table 2). This score indicates that respondents could perform about 8.5 of the 16 t-ADL activities independently. As can be seen in Table 2, mean performance on ADLs and mobility drops over the 2-year period.

On the t-ADL and mobility items, there was a good deal of heterogeneity, although the distribution of change scores

Table 1. Description of Sample for Two-Wave and Three-Wave Analyses

<table>
<thead>
<tr>
<th></th>
<th>Two-Wave Analysis (N = 147)</th>
<th>Three-Wave Analysis (N = 95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>86.8</td>
<td>86.8</td>
</tr>
<tr>
<td>(SD)</td>
<td>(2.3)</td>
<td>(2.3)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Female</td>
<td>66.7</td>
<td>74.0</td>
</tr>
<tr>
<td>% Male</td>
<td>33.3</td>
<td>26.0</td>
</tr>
<tr>
<td>Mean education (years)</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>(SD)</td>
<td>(1.7)</td>
<td>(1.4)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Married</td>
<td>24.8</td>
<td>23.1</td>
</tr>
<tr>
<td>% Unmarried</td>
<td>75.2</td>
<td>76.9</td>
</tr>
<tr>
<td>Residential status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ordinary</td>
<td>76.5</td>
<td>83.0</td>
</tr>
<tr>
<td>% Service housing</td>
<td>22.9</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Note: BP = blood pressure.
decided to categorize respondents into two groups: stable (including people with small amounts of improvement) and decline (people who declined 4 or more points on the t-ADL and mobility scales).

Logistic regression analysis was then used to identify the variables associated with stability and decline. In the analyses, stability was coded as 1, so that positive coefficients indicated that an independent variable was associated with stability. All of the predictors for the logistic regression analyses reflected the subjects' performance at Wave 1. The predictor variables were entered hierarchically in blocks (demographics, vitality, and psychological), and then a final model was constructed using the variables that emerged as predictors in the first set of regression runs. Only those variables with high bivariate associations to stability and decline were candidates for being included in the analysis. To test whether these variables would be carried into the final model, several models were constructed to see how well each domain (demographics, vitality, or psychological) predicted membership in the stable group. The results of the reduced model are shown in Table 3. The value estimates for Exp(b) indicate the relative odds of being classified in the stable group versus the decline group. Three variables were found to have a significant relation to stability in ADLs across the 2-year period: housing status, subjective health, and mastery (p < .05). Controlling for the other variables, people living independently in the community at baseline were more likely to remain stable in t-ADL functioning. People with better perceived health also had a greater likelihood of remaining stable. Finally, those with higher mastery at Wave 1 had a greater likelihood of stability. None of the measures of vitality predicted stability across this period, once demographics and psychological variables were controlled.

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Turning to the results for mobility, the reduced logistic model included three significant predictors: lung function, subjective health, and mastery (see Table 3). In each case, higher lung function, subjective health, and mastery were statistically significant predictors of stability in mobility (p < .05). None of the other independent variables predicted stability versus decline.

### Four-Year Transition

The sociodemographic characteristics of the reduced sample were similar to that of the larger sample used for studying the 2-year transition (see Table 1).

Mean levels of the independent variables over time are shown in Table 4. As with the 2-year transition, the measures remained relatively stable over the 4-year period. T-ADL and mobility performance declined in this sample between Wave 1 and Wave 2, and then again from Wave 2 and Wave 3.

Examining the change in t-ADLs and mobility across the 4-year period (between Wave 1 and Wave 3), we again

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
<th>Wave 1 Mean</th>
<th>Wave 1 SD</th>
<th>Wave 2 Mean</th>
<th>Wave 2 SD</th>
<th>Wave 3 Mean</th>
<th>Wave 3 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic BP</td>
<td>110</td>
<td>200</td>
<td>100</td>
<td>160.32</td>
<td>17.34</td>
<td>156.67</td>
<td>19.14</td>
<td>155.53</td>
<td>27.30</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>30</td>
<td>110</td>
<td>80</td>
<td>82.39</td>
<td>9.27</td>
<td>80.21</td>
<td>8.84</td>
<td>76.55</td>
<td>13.17</td>
</tr>
<tr>
<td>Lung function</td>
<td>60</td>
<td>480</td>
<td>420</td>
<td>219.52</td>
<td>101.38</td>
<td>202.10</td>
<td>79.77</td>
<td>222.18</td>
<td>105.06</td>
</tr>
<tr>
<td>Pulse</td>
<td>40</td>
<td>120</td>
<td>80</td>
<td>73.66</td>
<td>9.72</td>
<td>71.50</td>
<td>7.59</td>
<td>69.16</td>
<td>11.21</td>
</tr>
<tr>
<td>Grip strength</td>
<td>0</td>
<td>200</td>
<td>200</td>
<td>98.53</td>
<td>30.77</td>
<td>85.86</td>
<td>29.62</td>
<td>72.30</td>
<td>30.60</td>
</tr>
<tr>
<td>Psychological</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mastery</td>
<td>0 = low</td>
<td>5 = high</td>
<td>5</td>
<td>2.90</td>
<td>0.41</td>
<td>2.90</td>
<td>0.33</td>
<td>2.92</td>
<td>0.43</td>
</tr>
<tr>
<td>Depression</td>
<td>0 = high</td>
<td>4 = low</td>
<td>4</td>
<td>3.33</td>
<td>0.48</td>
<td>3.25</td>
<td>0.43</td>
<td>3.26</td>
<td>0.45</td>
</tr>
<tr>
<td>Subject's health</td>
<td>1 = low</td>
<td>7 = high</td>
<td>6</td>
<td>5.57</td>
<td>1.06</td>
<td>5.30</td>
<td>0.96</td>
<td>5.25</td>
<td>1.07</td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td>0 = cannot do</td>
<td>42 = no difficulty</td>
<td>42</td>
<td>35.79</td>
<td>7.06</td>
<td>30.16</td>
<td>10.66</td>
<td>27.84</td>
<td>11.51</td>
</tr>
<tr>
<td>Mobility</td>
<td>0 = cannot do</td>
<td>24 = no difficulty</td>
<td>24</td>
<td>21.67</td>
<td>3.27</td>
<td>17.66</td>
<td>6.10</td>
<td>17.59</td>
<td>5.98</td>
</tr>
</tbody>
</table>

Notes: BP = blood pressure, ADL = activities of daily living.
found a similar pattern of skewed distribution scores. Thus, we used the same analytic approach, categorizing people into stable or declining groups. On the t-ADL measure, 43% of the sample was stable while 57% had declined. The results for mobility were 62% stable and 38% declined.

The logistic analysis strategy was similar to the 2-year transition analysis. That is, to predict stability over the 4-year period, we again used predictors from the subjects' baseline (Wave 1) performance and entered them into the logistic regression analysis in the same blocks as for the analysis involving the 2-year transition. Table 5 shows the results of logistic regression analyses over the 4-year period. For t-ADLs only one demographic variable, residential status at Wave 1, was a risk factor for stability by Wave 3. The subjects who lived in the community when the study began had a greater likelihood of remaining stable in t-ADL performance over the 4-year period. The variables Subjective Health and Mastery, which were statistically significant predictors for t-ADL stability for the 2-year transition, were not significant predictors for the four-wave transition, although their parameter estimates indicated that their effects were in the same direction as for the 2-year analysis. None of the other psychological or vitality measures were significantly associated with stability versus decline. Age, marital status, grip strength, and mastery were significant predictors for stability on mobility. Younger respondents, those who were unmarried, with higher grip strength, and with higher levels of mastery had a greater likelihood of remaining stable on mobility. Subjective health and lung function, variables that were statistically significant for the 2-year transition, did not emerge as significant predictors for the 4-year analysis although again, their parameter estimates indicated that their effect was in the same direction as the 2-year analysis.

DISCUSSION

This study examined patterns of stability and decline in a population-based sample of the oldest old. The view of this age group typically emphasizes decline and disability, and our study also found evidence of considerable decline. Over the 4-year period we found a decrease in our sample size by almost two-thirds because of death, dementia, or increased frailty of the sample. Although this attrition rate seems high, it is very typical of adults in this very old age group. The sample for this study came from a population-based sample of the oldest old, meaning that no one was excluded based on residential status or cognitive function. Participants were drawn from nursing homes and sheltered housing as well as the community.

While we found considerable evidence of decline, we also identified people who did not decline in functioning over the 2- and 4-year assessment periods. We were encouraged by this heterogeneity in the oldest groups and were particularly interested in the individuals who remained stable or improved over time. By comparing those people who were stable with those who declined, we hoped to shed light on the factors associated with stability in functioning at these advanced ages.

In general, demographic variables had inconsistent associations with functional outcomes. Age emerged as a significant predictor, as did marital status only for mobility functioning over 4 years. Gender had no apparent relation, perhaps in part because the sample was predominantly women, which reflects the higher rate of survival of women into their mid- to late 80s. Interestingly, residential status (community-dwellers vs those living in sheltered housing) did have a significant association with stability in ADL functioning, and this effect of residential status remained after 4 years. Possible explanations for the observed relation may be that some of the people in sheltered housing moved in recognition of decline that was occurring prior to the first wave of measurement and was continuing through the study. It is also possible that an institutional setting fosters people to give up control over some areas of their lives, inadvertently promoting decline. Indeed, research has provided dramatic evidence of how nursing homes reinforce dependence and so increase decline toward disability (Baltes, Kinderman, Reisenzein, & Schmid, 1987). Within the institutional environment, subtle processes may be at work whereby staff promote a more passive stance to the world that is reflected in the respondents' higher ratings of disability. These findings seem to uncover the importance of the physical environment on disability.

In addition to the effect of the physical environment, we also found psychological resources to have some effect on disability. In the short term, global subjective health was associated with stability over a 2-year period. This finding is consistent with previous research that proposes that the individual's perception of health reflects his or her social position or somehow captures prodromal syndromes (Idler & Kasl, 1995; Schoenfeld et al., 1994). After controlling for the vitality measures, subjective health can predict future disability by identifying the respondents at risk for detrimental changes that are not yet apparent in the objective vitality indicators. According to our findings, the predictive power of subjective health seems to be short-term, rather than long-term. These findings may suggest that knowing an individual's self-rating of health is more useful for understanding short-term changes in functioning than long-term changes in disability.

Along with subjective health, mastery emerged as a significant predictor for short-term changes in t-ADLs and short- and long-term changes in mobility. This finding lends support to a growing literature on the importance of a sense
of mastery or personal control for good functioning in very late life (Roberts et al., 1994; Schoenfeld et al., 1994). The idea is that a person's ability depends on interactions between behavior and beliefs; that is, mastery can affect levels of activity such that a person with low mastery beliefs could have reduced activity while someone with high mastery beliefs could have increased activity. As a cognitive process, mastery beliefs can also modify the meaning of challenging situations, such that a person with higher mastery may be better able (cognitively and physically) to compensate for losses, conserve resources, or cash in on available physical or environmental resources.

The relation of psychological variables to changes in t-ADL mobility and performance was not consistent across all comparisons, particularly at Wave 3. Some of the predictors had effects that were more immediate rather than long-term in nature. For example, subjective health had a statistically significant effect for the 2-year analysis, but not for the 4-year analysis. Mastery was shown to have a long-term effect for mobility but not for t-ADL performance; however, by Wave 3 the reduced sample size reduced the power of our analysis such that significant multivariate effects may not have been detected. There were, however, significant univariate relations between subjective health and mastery on stability in both functional measurements. Our findings should be viewed as tentative, but point to the importance of mastery and subjective health as predictors of stable functioning. Additionally, had we included a measure of cognitive performance, our analyses may have uncovered different relations, since both mastery and IADL performance have strong cognitive components. Since our analysis tested main effects of specific variables, future work should focus on identifying other variables and mediating or moderating effects to uncover more complicated mechanisms for stability.

Turning to the biomedical variables, we found that they had no significant relations to changes in t-ADL performance and inconsistent relations to changes in mobility. We do not imply that biomedical variables do not influence t-ADL performance; changes in functional ability may be greatly influenced by disease, both past and present, that in our study was not examined and could have significant relationships to stability. Rather, we suggest that other variables that operate independently or in conjunction with disease could operate to stabilize an individual in this age group. Future research that includes incident disease and other time-varying covariates could better uncover the complex relations among demographics, biomedical variables, and psychological constructs.

In general, our findings can help clinicians who could be more informed by looking beyond the physical impairments of the elderly person to his or her mental health. How people view their effectiveness and their own health has an important role for their continued functioning. We feel that our study builds and extends the concepts of successful aging developed with younger age groups (Baltes & Baltes, 1986). The importance of mastery and subjective health as predictors of successful aging, particularly in the oldest old. These ideas can shape expectations that guide research and intervention, the implications of which can lead to a greater understanding of successful aging, particularly in the oldest age groups.

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