Activities of Daily Living Function and Disability in Older Adults in a Randomized Trial of the Health Enhancement Program

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Background. Disability in basic activities of daily living (ADLs) implies a loss of independence and increases the risk for hospitalization, nursing home admission, and death. Little is known about ways by which ADL disability can be prevented or reversed. The authors evaluated the efficacy of the Health Enhancement Program in preventing and reducing ADL disability in community-dwelling older adults.

Methods. The authors analyzed data from a 12-month, randomized, single-blinded, controlled trial of a disability prevention, chronic disease self-management program involving 201 adults aged 70 years and older that was conducted from February 1995 to June 1996 at a senior center in western Washington state. Activities of daily living disability incidence, improvement, and worsening were assessed using intention-to-treat methods.

Results. The cumulative incidence of ADL disability among those who were not ADL disabled at baseline ($n = 56$ in the intervention group, $n = 57$ in the control group) was modestly lower in the intervention group than in the control group at 12 months (14.3% vs 21.3%, $p = .466$). Cumulative improvement in ADL function among those who reported any ADL disability at baseline ($n = 41$ in the intervention group, $n = 43$ in the control group) was greater in the intervention group at 12 months (80.5% vs 46.5%, $p = .026$). The likelihood for ADL improvement was greater in the intervention group compared with controls at 12 months (adjusted hazard ratio, 1.84; 95% confidence interval, 1.05 to 3.22; $p = .020$). Cumulative worsening of ADL function was slightly lower in the intervention group at 12 months (18.6% vs 26.5%, $p = .237$). Intervention participants tended to be at lower risk for ADL worsening (adjusted hazard ratio, 0.71; 95% confidence interval, 0.38 to 1.30; $p = .466$) compared with control participants.

Conclusion. The Health Enhancement Program intervention led to improved ADL functioning in those who were disabled initially and thereby offers a promising strategy for limiting or reversing functional decline in disabled elderly persons.

THE Health Enhancement Program (HEP) is a community-based intervention designed to promote the health and functioning of community-dwelling elderly persons (1). It was designed to identify modifiable risk factors for disability, promote behavior change to reverse those risk factors, and enhance self-management of chronic conditions. In a randomized trial of HEP, participants in the intervention arm had less functional decline as measured by bed disability days and the Health Assessment Questionnaire (HAQ) Disability Index (2,3) and fewer hospitalizations compared with control participants (1).

The HAQ data from the trial allowed us to determine whether the HEP intervention had any influence on disability in basic activities of daily living (ADLs), which is defined as difficulty with or inability to perform self-care activities. Such disability increases the risk for hospitalization, nursing home admission, and death (4–6). Reducing functional disability has been described as a critical health issue (7), but few strategies to prevent ADL disability have been described (8,9). The authors of the HEP efficacy trial (1) reported the overall score on the HAQ Disability Index. The HAQ Disability Index measures function in a variety of domains, including instrumental (IADLs), upper extremity function, mobility, and basic ADLs. It has been widely used in research and has excellent test–retest reliability, construct and predictive validity, and responsiveness (3). Here we address three concerns about the effect of the HEP intervention on ADL disability that have not been evaluated previously: Does the HEP intervention (a) prevent the development of new ADL disability in those who are not disabled at enrollment, (b) improve ADL function in those reporting ADL disability at enrollment, and (c) prevent worsening of ADL function, regardless of ADL status at enrollment?

Methods

Design

The HEP was a randomized controlled trial with 1 year of follow-up testing of the efficacy of the HEP versus the control intervention. The primary outcomes are reported elsewhere (1).
Setting
The HEP trial was conducted at a senior citizens center north of Seattle, Washington. Institutional review committees at the Group Health Cooperative of Puget Sound and PacifiCare of Washington and Senior Services of Seattle/King County approved the study.

Participants
Physicians of two health maintenance organizations in practices near the senior center referred patients who had ≥1 chronic condition and were aged 70 years or older. Other eligibility criteria included (a) senior center non-participation and (b) self-reported ability to walk and perform ADLs without help. Individuals were eligible if they had difficulty performing ADLs but did not require human help. Exclusion criteria were a score of ≤18 on the Mini-Mental State Examination (10) or a score of 19 to 26 with evidence of cognitive impairment noted in a geron-logic nurse practitioner (GNP) assessment.

Randomization
One hundred one participants were allocated to the intervention and 100 to the control group by random selection by each participant of a labeled table tennis ball from a box. Each participant gave written informed consent before randomization.

Intervention
The intervention, described in detail previously (1), is summarized here. The program was based on the Buchner/Wagner model of disability, wherein predictors of disability can be modified to reduce susceptibility to functional decline (11). The GNP contacted the primary care providers of intervention participants to obtain information about health problems and then met individually with each participant. The GNP gathered health and risk factor information during a baseline assessment and developed a "health action plan" tailored to the participant’s goals and preferences. Disability risk factors addressed included inadequate control or self-management of chronic conditions (hypertension or diabetes, for example), use of unnecessary psychoactive medications, physical inactivity, depression, and social isolation.

The GNP encouraged all intervention participants to enroll in any or all of three core offerings: an evidence-based exercise class (Lifetime Fitness Program) (12); chronic disease self-management classes (13); and pairing with a trained volunteer senior (health mentor) for peer support (14). Participants with depressive symptoms were referred to an HEP social worker for assessment and brief counseling, inclusion in a support group, or both. The GNP encouraged intervention participants who chose not to participate in the Lifetime Fitness Program to follow an exercise program at home or with another group. The GNP reported to primary care physicians all details of their patients’ participation and acute situations when encountered. After the initial meeting with each intervention participant, the GNP monitored progress toward health goals through follow-up visits and telephone calls. On average, the GNP had 3 in-person meetings and 9 calls to each participant during the 12-month program.

Control participants received a tour of the senior center and a schedule of senior center activities but did not meet with the GNP.

Data Collection
Participants completed mailed questionnaires about demographics, health behaviors, health and functional status, self-efficacy, and health care utilization at enrollment and 6 and 12 months after enrollment. The research staff was not involved in the intervention and were blinded to group assignment.

Outcome measures.—Our primary outcome measure was ADL disability, or having some or much difficulty or being unable to perform any of the ADLs elicited by the HAQ (2,3): dressing, rising from a chair, getting in and out of bed, cutting meat, lifting a cup, washing and drying their bodies, taking a bath, and getting on and off the toilet. For participants who were missing HAQ ADL data at either 6 or 12 months (n = 9), we imputed ADL status from the bathing item of the Medical Outcomes Study Short Form–36 (SF-36) physical function subscale (15–17). Because disability in bathing generally represents the first ADL in which most persons become disabled and is the most common ADL disability, imputing on bathing was most likely to identify the greatest number of persons with new ADL disability. Participants who withdrew before their 6-month follow-up visit and were without outcome data on either the HAQ or the SF-36 bathing item at either 6 or 12 months were excluded from the analyses (n = 4, see Figure 1). Participants who died were assigned the maximum disability score for time after their death.

Demographic and health-related measures.—Demographic variables assessed at baseline included those associated with functional decline: age, sex, income, and marital status. Participants reported chronic conditions by answering the question “Has your doctor ever told you you’ve had . . .?” for a list of chronic conditions. Current smoking status was assessed with the question “Do you smoke any cigarettes at the present time?” Medical Outcomes Study self-rated health was our measure of health status (15–17). Physical activity was assessed using the Physician-based Assessment and Counseling for Exercise scale (18). Baseline ADL function was based on the 8 HAQ ADL items. For each item, the response options were no (score = 1), some (score = 2), or much (score = 3) difficulty or unable to do (score = 4). The ADL score was the average response to the 8 items. Thus, the range of possible ADL scores was 1 (no ADL disability) to 4 (unable to do any ADLs).

Data Analysis
The sample size for the trial was based on effect sizes observed in the SF-36 physical function and physical limitations subscales from a trial conducted with older adults at the same senior center (12).
Differences between study groups at baseline were tested using chi-square analysis for categorical variables and $t$ tests for continuous variables. The assumption of constant hazard rates was checked with log ($-\log$ [survival]) curves and with tests of the interaction of time with the study group variable. We used Cox proportional hazards regression and the Wilcoxon test of survivor functions to evaluate effects of the intervention on risk of incident ADL disability and improvement and worsening of ADL function. We confirmed our results by comparing them to results from discrete-time survival analysis, a variation of proportional hazards regression that allows estimation when the exact

Figure 1. Flow of participants through the randomized trial of the Health Enhancement Program and analyses. *Ns included those who died because those who died were imputed as disabled; †Ns included participants whose data were imputed.
Table 1. Demographic and Health Characteristics of Participants at Baseline by Study Group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention (N = 97)</th>
<th>Control (N = 100)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y), mean ± SD</td>
<td>77.1 ± 5.1</td>
<td>76.9 ± 5.2</td>
<td>.724</td>
</tr>
<tr>
<td>Female (%)</td>
<td>64.9</td>
<td>48.0</td>
<td>.016</td>
</tr>
<tr>
<td>Income &lt;$15,000/y (%)</td>
<td>31.0</td>
<td>27.1</td>
<td>.577</td>
</tr>
<tr>
<td>Married (%)</td>
<td>52.6</td>
<td>71.0</td>
<td>.008</td>
</tr>
<tr>
<td>Chronic medical conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number of conditions</td>
<td>3.4</td>
<td>3.2</td>
<td>.724</td>
</tr>
<tr>
<td>CHD (%)</td>
<td>33.0</td>
<td>41.4</td>
<td>.223</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>13.5</td>
<td>7.0</td>
<td>.130</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>55.7</td>
<td>57.0</td>
<td>.851</td>
</tr>
<tr>
<td>Arthritis (%)</td>
<td>63.9</td>
<td>64.6</td>
<td>.915</td>
</tr>
<tr>
<td>Nervous/mental problems (%)</td>
<td>12.5</td>
<td>8.0</td>
<td>.298</td>
</tr>
<tr>
<td>Cancer (%)</td>
<td>18.6</td>
<td>25.0</td>
<td>.274</td>
</tr>
<tr>
<td>Current smoker (%)</td>
<td>4.1</td>
<td>9.0</td>
<td>.168</td>
</tr>
<tr>
<td>Self-rated health good or better (%)</td>
<td>80.4</td>
<td>79.0</td>
<td>.237</td>
</tr>
<tr>
<td>Moderate exercise in past year (%)</td>
<td>35.1</td>
<td>33.3</td>
<td>.800</td>
</tr>
<tr>
<td>Any difficulty in at least 1 IADL (%)</td>
<td>42.3</td>
<td>38.0</td>
<td>.541</td>
</tr>
<tr>
<td>Any difficulty in at least 1 ADL (%)</td>
<td>42.3</td>
<td>43.0</td>
<td>.917</td>
</tr>
</tbody>
</table>

Notes: *Study groups comprised of participants with Health Assessment Questionnaire ADL information at baseline and either 6 or 12 months of follow-up.
1 Chi-square test done on all response options for the question.
2 Moderate (3-4 times per week) exercise defined as PACE (Physician-based Assessment and Counselling for Exercise scale) score ≥ 6.
3 IADL = instrumental activities of daily living; ADL = basic activities of daily living; SD = standard deviation; CHD = coronary heart disease.

RESULTS

Figure 1 describes the flow of participants through each stage of the trial and the analyses we describe here. Of the 201 participants who were enrolled, 1 intervention and 2 control participants died, and 4 from the intervention group dropped out before their 6-month follow-up. Fifty-six intervention participants and 57 controls were not ADL disabled at baseline. There were 41 ADL-disabled participants in the intervention group and 43 in the control group at baseline.

Table 1 shows demographic and health characteristics of participants at enrollment, by study group. Intervention and control participants had similar ages and incomes. The intervention group had more women and fewer married participants. More intervention participants had diabetes (13.5% vs 7%), but this difference was not statistically significant. The groups were similar based on functional measures and behavioral risk factors.

Tables 2, 3, and 4 show results of the incident ADL disability, improvement, and worsening analyses, respectively. In the adjusted models in these analyses, we controlled for baseline differences in sex and for the incident improvement and worsening analyses in ADL function. We did not control for marital status, because marital status correlated strongly with sex (data not shown), and including it in the model did not alter the findings. We did not control for age, because age was not statistically significantly different between the study groups at baseline. We also adjusted for a broader range of functioning using the HAQ score (which includes IADLs, upper extremity function, and mobility), and we saw no difference in the results.

As shown in Table 2, among the 113 participants with no ADL disability at baseline, ADL disability developed in 8 (14.3%) in the intervention group and 6 (10.5%) in the control group at 6 months. This number remained stable in the intervention group but increased to 12 (21.3%) in the control group by 12 months. After adjustment for sex, the relative risk for incident ADL disability was 0.68 (95% confidence interval [CI], 0.27 to 1.70; p = .411) for those in the intervention group compared with the control group.

Table 2. Incidence of Disability in Basic ADLs Over 12 Months Among Those With No ADL Disability at Baseline

<table>
<thead>
<tr>
<th>Group</th>
<th>Cumulative No. Becoming Disabled</th>
<th>Cumulative % Disabled*</th>
<th>Unadjusted Relative Risk at 12 Mo (95% CI)</th>
<th>Adjusted Relative Risk at 12 Mo (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 Mo</td>
<td>12 Mo</td>
<td>6 Mo</td>
<td>12 Mo</td>
</tr>
<tr>
<td>Intervention</td>
<td>56</td>
<td>8</td>
<td>8</td>
<td>14.3</td>
</tr>
<tr>
<td>Control</td>
<td>57</td>
<td>6</td>
<td>12</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Notes: *Cumulative hazard function (number of terminal events/number exposed to risk) at end of interval.
1 Cox proportional hazards, Wilcoxon test of survivor functions.
2 Adjusted for sex.
CI = confidence interval; ADLs = activities of daily living.
To our knowledge, our study is the first to show that a modest intervention effect on those outcomes as well. We found little difference between groups in risk for increased difficulty with ADLs at baseline (13.4% of intervention participants vs 16% of controls). Among the entire study population (Table 4), regardless of difficulty with ADLs at baseline, we found little difference between groups in risk for increased difficulty with ADLs at 6 months (13.4% of intervention participants vs 16% of controls). A modest difference was observed by 12 months (13.4% of intervention participants vs 18.6% of controls). After adjusting for sex and baseline ADL function, the relative risk for worsening of ADL function was 0.71 (95% CI, 0.38–1.30; p = .266) for the intervention group compared with the control group.

Among those who were ADL disabled at baseline (n = 84), more intervention than control participants improved in ADL function at both 6 and 12 months (Table 3). Fewer than half of control participants (20 participants, or 46.5%) improved ADL function between baseline and 6 or 12 months, whereas 63.4% of intervention participants improved by 6 months and 80.5% improved by 12 months. After adjustment for sex and baseline ADL function, the likelihood for improvement in ADL function was 1.84 (95% CI, 1.05–3.22; p = .026) for the intervention group compared with the control group.

These analyses suggest that the HEP intervention is effective in improving ADL function in community-dwelling elderly persons with mild to moderate ADL disability. Although we did not find a statistically significant effect on the development of new ADL disability or on worsening of ADL function, the results were in the direction of a modest intervention effect on those outcomes as well. To our knowledge, our study is the first to show that a community-based preventive health program may improve ADL function in elderly persons with ADL disability.

The mechanism for the observed beneficial effect on ADL function is likely increased self-management of chronic diseases and reduction in risk factors for disability, achieved through a careful initial assessment and subsequent tracking of intervention participants by the GNP. Regardless of which component(s) of the intervention the participant engaged in, addressing disease-related (e.g., depression) and behavioral risk factors (e.g., physical inactivity, social isolation) for disability remained the GNP’s ongoing priority. The GNP provided self-management support, working with participants to help them understand and manage the symptoms of their chronic conditions and encouraging compliance with medications prescribed for treatment of those conditions. The efficacy trial showed that the intervention resulted in increased physical activity and social participation, reduced hospitalizations with no change in primary care visits (suggestive of improved disease self-management), and reduced psychoactive medication use (1). These findings provide support for our hypothesized mechanism for the observed effect.

The HEP intervention appeared to improve ADL function most strongly among those with ADL disability, with a less pronounced effect among those who were nondisabled at baseline. Possible explanations for this difference may be that the intervention works especially well for persons who are less robust, or that the incidence of ADL disability during the course of 1 year is not large, and therefore it would be less likely that an effect would be observed among healthier persons during an intervention with 1 year of follow-up.

### Table 3. Incidence of Improvement in ADL Function over 12 Months Among Those With Any ADL Disability at Baseline

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>6 Mo</th>
<th>12 Mo</th>
<th>6 Mo</th>
<th>12 Mo</th>
<th>p&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Unadjusted Relative Risk at 12 Mo (95% CI)</th>
<th>Adjusted Relative Risk at 12 Mo (95% CI)&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>41</td>
<td>26</td>
<td>33</td>
<td>63.4</td>
<td>80.5</td>
<td>.026</td>
<td>1.79 (1.03–3.12)</td>
<td>1.84 (1.05–3.22)</td>
</tr>
<tr>
<td>Control</td>
<td>43</td>
<td>20</td>
<td>20</td>
<td>46.5</td>
<td>46.5</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Notes:**<sup>1</sup>Cumulative hazard function (number of terminal events/number exposed to risk) at end of interval.<br><sup>2</sup>Cox proportional hazards, Wilcoxon test of survivor functions.

### Table 4. Incidence of Worsening in ADL Function Over 12 Months Among Entire Study Population

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>6 Mo</th>
<th>12 Mo</th>
<th>6 Mo</th>
<th>12 Mo</th>
<th>p&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Unadjusted Relative Risk at 12 Mo (95% CI)</th>
<th>Adjusted Relative Risk at 12 Mo (95% CI)&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>97</td>
<td>13</td>
<td>18</td>
<td>13.4</td>
<td>18.6</td>
<td>0.237</td>
<td>0.70 (0.38–1.27)</td>
<td>0.71 (0.38–1.30)</td>
</tr>
<tr>
<td>Control</td>
<td>100</td>
<td>16</td>
<td>26</td>
<td>16.0</td>
<td>26.5</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Notes:**<sup>1</sup>Cumulative hazard function (number of terminal events/number exposed to risk) at end of interval.<br><sup>2</sup>Cox proportional hazards, Wilcoxon test of survivor functions.

ADL = activities of daily living; CI = confidence interval.
Our results can be contextualized by comparing them to those from other multicomponent, preventive interventions for community-dwelling elderly persons. A systematic review of studies of preventive home visit programs showed that such programs are effective in decreasing the risk for functional decline if they are based on multidimensional geriatric assessment, involve extended follow-up, and target persons with relatively good function at baseline (9). However, the interventions included in the review led primarily to reduced IADL disability, with little effect on ADL function. Furthermore, in some studies, one ADL, rather than the entire range of ADL functions, was analyzed as the ADL outcome measure.

The primary limitation of our study is the limited sample size. Nonetheless, we did observe important effects on ADL disability. A second limitation is the lack of detailed process data quantifying the degree of participation in the three core components (exercise, self-management classes, and mentoring program). This information would be useful to fully characterize the nature of the intervention received but was not collected as part of the trial. A third limitation is the generalizability of the findings. Our population was middle class, white, and suburban. We do not know whether the program would be more or less effective in a more diverse population. In an evaluation of a local dissemination of HEP, the program appeared to be beneficial in a somewhat lower income, slightly more diverse group (19). Other limitations that deserve mention include the fact that the study was conducted in one geographic locale at a single senior center with only two selected managed care organizations and involved one GNP. This particular GNP may have been a particularly important part of the intervention, such that other GNP's or providers might not be able to generate the same positive results.

Finally, given that the study groups were not completely balanced at baseline on sex and marital status, concerns may be raised about the adequacy of randomization. However, because we could account for this possible imbalance for the purposes of the analyses through statistical methods (adjustment), this latter limitation is unlikely to have affected our results.

These limitations notwithstanding, our study has several strengths. We believe this is the first multicomponent, preventive intervention that has been shown to improve ADL function in community-dwelling elderly persons. The community-based nature of the intervention is unique, permitting an emphasis on self-care and social support while maintaining contact with the PCP. The HEP can be provided at low cost (approximately $300 per participant per year), because the community venue offers a broad range of activities and resources for promoting health and social interaction. The community-based infrastructure holds promise in providing enduring support for behavior change and disability prevention.

Addressing ADL disability is imperative as the aging population expands. Interventions that can prevent, delay, or lessen ADL disability are needed. The HEP intervention may represent an effective strategy to this end.

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