

# Effect of an In-Home Occupational and Physical Therapy Intervention on Reducing Mortality in Functionally Vulnerable Older People: Preliminary Findings

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**OBJECTIVES:** To evaluate the effect of a multicomponent intervention on mortality and the role of control-oriented strategy use as the change mechanism.

**DESIGN:** Two-group randomized design with survivorship followed for 14 months. Participants were randomized to intervention or a no-treatment control group.

**SETTING:** Urban, community-living older people.

**PARTICIPANTS:** Three hundred nineteen people aged 70 and older with functional difficulties.

**INTERVENTION:** Occupational therapy and physical therapy sessions involving home modifications, problem solving, and training in energy conservation, safe performance, balance, muscle strength, and fall recovery techniques.

**MEASUREMENTS:** Survival time was number of days between baseline interview and date of death or final interview if date unknown. Control-oriented strategy use was measured using eight items.

**RESULTS:** Intervention participants exhibited a 1% rate of mortality, compared with a 10% rate for no-treatment control participants ( $P = .003$ , 95% confidence interval = 2.4–15.04%). At baseline, those who subsequently died had more days hospitalized and lower control-oriented strategy use 6 months before study enrollment than survivors. No intervention participants with previous days hospitalized ( $n = 31$ ) died, whereas 21% of control group counterparts did ( $n = 35$ ;  $P = .001$ ). Although intervention participants with low and high baseline control strategy use had lower mortality risk than control participants, mortality risk was lower for intervention participants with low strategy use at baseline ( $P = .007$ ).

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**CONCLUSION:** An occupational and physical therapy intervention to ameliorate functional difficulties may reduce mortality risk in community-dwelling older people overall and benefit those most compromised. Instruction in control-oriented strategies may account for the intervention's protective effects on survivorship. *J Am Geriatr Soc* 54:950–955, 2006.

**Key words:** home care; control; frailty; rehabilitation; home modification

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Functional decline and associated activity limitations represent a major consequence of chronic illnesses, contributing to poorer quality of life and greater healthcare costs in older people.<sup>1</sup> Moreover, functional disability has been linked to mortality independent of disease state and other health factors in older persons.<sup>2–5</sup> Given the far-reaching health, social, financial, psychological, and mortality effects of disability, developing and testing interventions to offset the functional consequences of chronic disease is an important public health priority.

The expanding research literature on the effects of interventions on functional decline report inconsistent outcomes, with little attention given to mortality risk reduction.<sup>6,7</sup> Although a few studies have reported that home nurse visitations reduce mortality risk, other intervention studies targeting functional decline find no survivorship benefits or have not systematically examined reducing the risk of mortality as an outcome.<sup>8</sup>

This randomized, controlled trial of 319 functionally vulnerable adults aged 70 and older indicated that a multicomponent intervention involving occupational and physical therapy and home modification reduced difficulties with instrumental activities of daily living (IADLs) and activities of daily living (ADLs), fear of falling, and home hazards and enhanced self-efficacy and use of adaptive control-oriented strategies at 6 months. It also showed that the magnitude of 12-month effects was similar to those at 6 months for most outcomes.<sup>9</sup> Thus, the intervention had

important clinical and quality-of-life improvements and reduced known risk factors for disability and falls such as home hazards, fear of falling, and functional difficulties. Also, experimental subjects showed significant improvements in areas of greatest difficulty at study entry, including bathing and mobility.

The purpose of this study was to evaluate the intervention effect on mortality and to consider potential mechanisms by which it affords protection against mortality, particularly the role of control-oriented strategy use.

## METHODS

### Study Sample and Procedures

Participants were recruited in the study between 2000 and 2003 from local social service agencies, an area agency on aging, and media announcements in the Philadelphia region. Study procedures were explained to interested persons who contacted the research staff. They were then screened by telephone to determine eligibility. All participants were aged 70 and older, cognitively intact (Mini-Mental State Examination<sup>10</sup> score >23 on a scale ranging from 0 to 30), English speaking, not receiving home occupational therapy or physical therapy, and functionally vulnerable. Functional vulnerability was defined as needing help with two IADLs, having difficulty performing one ADL, or experiencing one or more falls within 1 year before study entry.<sup>11</sup> The inclusion criteria were designed to obtain a sample of older people with functional difficulties but who were not homebound, totally dependent, or receiving home care.

Eligible and willing participants were interviewed at home after obtaining written informed consent using an approved institutional review board form. Study participants were stratified by race (white, nonwhite) and living arrangement (alone, with others) and randomized by the project director within each of four stratum using random permuted blocks to control for possible subject mix changes over time. Trained interviewers who remained masked to group assignment interviewed participants at 6 and 12 months.

### Intervention Group

Disablement models and the Life Span Theory of Control guided the multicomponent intervention.<sup>12</sup> The theory suggests that humans are motivated to exert control over behavior-event contingencies in their environments throughout their life spans. Applied to disablement, this suggests that the progression from pathology to disability presents increasing threats to control that in turn result in negative affective and health consequences, particularly for older people.<sup>13</sup> In response to this threat, individuals adapt behavioral and cognitive strategies to maintain and enhance control over important life domains. Research shows that use of control-oriented strategies results in positive health and behavioral outcomes.<sup>14</sup>

The intervention introduced and trained participants in control-oriented strategies, including use of environmental modifications and behavioral (energy conservation, fall recovery techniques) and cognitive (problem-solving, reframing, willingness to learn different strategies) strategies that were designed to optimize performance and compensate for

declining abilities. Occupational therapists met with participants at home over 6 months for four visits (90 minutes) and one telephone contact (20 minutes). A physical therapist met with participants for one 90-minute session consisting of balance, muscle strengthening, and safe fall and recovery training. Over the following 6 months, participants received three telephone calls from the occupational therapist to reinforce strategy use and generalize strategies to new problems. A final 10-month visit was conducted to obtain intervention closure. The area agency on aging provided home modifications (grab bars, rails, seating devices) free of charge to intervention participants through grant funds.

For persons assigned to no-treatment control, no study contact or intervention was provided. At the conclusion of the 12-month interview, control participants received education materials on home safety and performance techniques.

### Primary Measures

#### *Health and Physical Function*

Self-report information was obtained on health-related factors (Table 1), including health conditions, days hospitalized 6 months before study entry, self-rated health, formal services, medications, emergency visits, and days in rehabilitation. Difficulty in ADLs, IADLs, and mobility was determined using a standardized measure.<sup>15</sup> For each activity, participants rated their difficulty level in the past month on a 5-point scale (1 = no difficulty to 5 = unable to do due to health problems).

#### *Mortality*

Mortality was assessed over 14 months (allowing a 2-month window after the 12-month planned assessment). Proxies (family members) who study participants had identified at the baseline interview confirmed deaths. Survival time was defined as the number of days between the baseline interview and the date of death or last interview or date of loss to follow-up because of nursing home placement, hospitalization, or discontinuation from study for other reasons.

#### *Control-Oriented Strategy Use*

An eight-item investigator-developed measure assessed use of control-oriented behavioral, cognitive, and environmental strategies. Items reflect approaches for managing the threat to loss of control over daily activities due to functional difficulties. (See Table 1 for items.) Participants rated the extent to which each item is true on a 4-point scale (1 = not at all true to 4 = very much true). A control-oriented strategy score was derived by averaging responses across the eight items, with higher mean values indicating greater strategy use (Cronbach  $\alpha = 0.69$ ).<sup>16</sup>

### Statistical Analysis

Chi-square and Wilcoxon rank-sum tests were used to compare baseline characteristics of experimental with those of control participants, as well as those of active participants with those of participants who died. Means, standard deviations, and ranges for measures were computed.

Table 1. Comparison of Active and Deceased Participants on Baseline Characteristics (N = 319)

Characteristic	Active (n = 305)	Deceased (n = 14)	Total (N = 319)	P-value
<b>Demographic</b>				
Age, mean $\pm$ SD	79.0 $\pm$ 6.0	79.9 $\pm$ 4.8	79.0 $\pm$ 5.9	.44
Race, %				.62
White	52.1	64.3	52.7	
African American	45.9	35.7	45.5	
Other	2.0	.0	1.8	
Sex, %				.30
Male	17.7	28.6	18.2	
Female	82.3	71.4	81.8	
Living arrangement, %				.26
Alone	62.3	50.0	61.8	
With others	37.7	50.0	38.2	
Education, %				.89
< high school	31.1	28.6	31.0	
High school	32.5	28.6	32.3	
> high school	36.4	42.8	36.7	
Income, median*	2.0	2.0	2.0	.16
<b>Health related, mean <math>\pm</math> SD</b>				
Health conditions <sup>  </sup>	7.0 (2.6)	5.6 (3.8)	6.9 (2.7)	.09
Self-rated health <sup>  </sup>	2.4 (0.5)	2.2 (0.3)	2.4 (0.5)	.50
Days in hospital <sup>†  </sup>	1.7 (1.7)	5.4 (8.3)	2.1 (7.3)	.02 <sup>§</sup>
Emergencies (%) <sup>‡</sup>	5.2	14.3	5.6	.15
Rehabilitations (%) <sup>‡  </sup>	2.0	0.0	1.9	.60
Doctor visits <sup>†  </sup>	7.5 (8.5)	5.4 (4.0)	7.4 (8.4)	.37
Medications <sup>  </sup>	7.4 (3.6)	7.3 (5.5)	7.4 (3.7)	.70
Formal services <sup>‡  </sup>	2.6 (1.9)	2.9 (1.9)	2.6 (1.9)	.39
<b>Physical function, mean <math>\pm</math> SD<sup>  </sup></b>				
Activity of daily living difficulty	1.8 (0.6)	1.7 (0.7)	1.8 (0.6)	.56
Mobility difficulty	2.5 (0.8)	2.6 (0.8)	2.5 (0.8)	.84
Instrumental activity of daily living difficulty	2.1 (0.6)	2.3 (0.8)	2.1 (0.6)	.24
<b>Affective, mean <math>\pm</math> SD<sup>  </sup></b>				
Anxiety	19.7 (6.4)	19.9 (7.9)	19.7 (6.5)	.94
Depression	14.5 (10.8)	14.1 (11.2)	14.5 (10.8)	.85
<b>Control, mean <math>\pm</math> SD<sup>  </sup></b>				
Control-Oriented Strategy Index	3.3 (0.5)	3.0 (0.5)	3.3 (0.5)	.03 <sup>§</sup>
Willingness to make changes to home	2.9 (1.2)	1.9 (0.9)	2.8 (1.2)	.01 <sup>§</sup>
Try to do things to feel safe	3.3 (1.0)	2.9 (1.1)	3.2 (1.0)	.12
Pace myself	3.1 (1.0)	2.9 (0.9)	3.1 (1.0)	.35
Willing to use special equipment	3.6 (0.7)	3.6 (0.6)	3.6 (0.7)	.91
Try to learn as much as possible	3.1 (1.0)	2.9 (0.9)	3.1 (1.0)	.20
Willing to ask others for help	3.6 (0.7)	3.6 (0.6)	3.6 (0.7)	.68
Decide to do something, confident will succeed	3.6 (0.7)	3.3 (0.9)	3.6 (0.7)	.21
Think about importance to stay healthy	3.1 (1.0)	2.9 (1.1)	3.1 (1.0)	.43

\* Income category = \$10,000–14,999 annually.

<sup>†</sup> During 6-month period immediately before randomization.

<sup>‡</sup> During 1-month period immediately before randomization.

<sup>§</sup> Significant results.

<sup>||</sup> Values = total score; Theoretical range for Anxiety = 1–40; Theoretical range for Depression = 0–60.

<sup>¶</sup> Values = mean score; Theoretical range for Self-rated health = 1–4; Physical Function = 1–5; Control = 1–4.

SD = standard deviation.

All analyses were conducted following the intention-to-treat principle, with survival over the 14-month study period as the primary outcome measure. Active participants were compared with those who died on all baseline variables; for variables in which there was a large or statistically significant difference, independent effects on mortality were evaluated. Kaplan-Meier survival curves were con-

structed to assess the probability of survival and were compared using the log rank test. In the Kaplan-Meier analyses, persons were censored if they dropped out for reasons other than death (discontinuation due to nursing home placement or other loss to follow-up) or were alive at the 12-month assessment. Five subjects dropped out because of nursing home placement. Because of the possibility that this was an

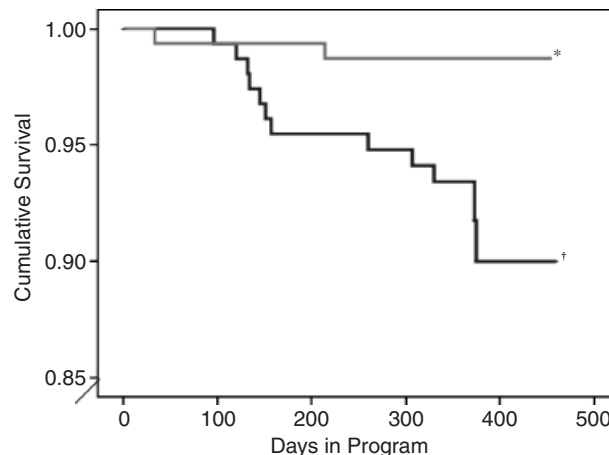
indicator of worsening physical condition (and thus of possible informative censoring), the analysis comparing intervention to control was also run treating these five subjects as if they had died at the time of placement. Results were essentially unchanged and are not reported. Risk differences and 95% confidence intervals were calculated. All analyses used SPSS version 13.0 with significance level set at .05 (SPSS Inc., Chicago, IL).

**RESULTS**

Of the 319 participants enrolled in the study, 34 (11%) were lost to follow-up, of whom 14 died and 20 were confirmed alive. Reasons for attrition other than death were unavailability for reassessment (n = 7), nursing home placement (n = 5), dissatisfaction with study (n = 4), illness (n = 2), hospitalization (n = 1), and relocation (n = 1). Of 20 persons confirmed alive, there were no statistically significant differences in attrition rate between intervention (n = 9) and control (n = 11) participants. Of the 14 who died, two were in intervention, one of whom died before receiving intervention, and 12 were in the control group. Reason for death was unknown for eight persons; two people died of cancer, one of emphysema, one of congestive heart failure, one of sepsis, and one of pneumonia.

There were no large or statistically significant differences at baseline between intervention and control group participants on main study outcomes or other variables, including number of health conditions, health status, social support, depression, anxiety, home hazards, number of home modifications, or demographics, such as age, sex, race, marital, and living status.<sup>9</sup> Participants' mean age ± standard deviation was 79 ± 5.9 (range 70–97). Fifty-three percent were white; 46% were African American. The majority of study participants were female (82%) and lived alone (62%). Thirty-one percent had less than a high school education, 32% had completed high school, and 37% had more than a high school education. Most participants reported little to no difficulty overall ambulating at home and performing IADLs and ADLs (Table 1). Specific areas for which participants had the most difficulties at baseline were grocery shopping (88%), climbing stairs (83%), walking one block (82%), dressing from waist down (70%), and bathing (64%). Also at baseline, participants had on average 3 ± 2.16 home modifications and 10 ± 9.7 observed home hazards. As to health, at baseline, participants reported seven health conditions, with 84% reporting arthritis, 71% hypertension, 43% cataracts or macular degeneration, 39% cardiovascular problems, and 23% diabetes. Furthermore, 70% rated their health as fair to poor, with 51% indicating that their health was not as good as it had been a year before.

A comparison of baseline characteristics of active participants (n = 305) with those who died (n = 14) revealed no large or statistically significant differences on any major study variables including age, number of home hazards and home modifications, social support, functional status, depression, anxiety, or health conditions except for two factors: days in hospital 6 months before study enrollment and control-oriented strategy use at baseline (Table 1). At baseline, those who subsequently died reported spending more



**Figure 1.** Survival functions of participants by group assignment. \*Intervention (n = 160, 1% mortality). †Control (n = 159, 10% mortality).

days in the hospital 6 months before study enrollment. Nevertheless, there were few differences in the major health conditions reported by those who lived and those who died; 93% of those who died had reported comorbidities, compared with 99% of those who lived, and 50% of those who died had reported cardiovascular disease, compared with 89% of those who lived. Also, those who died had reported at baseline lower control-oriented strategy use than those who survived. The only single item with a large difference and that reached statistical significance was willingness to make home modifications to stay independent. Kaplan-Meier survival curve analysis showed that intervention participants exhibited a 9% reduction in risk of 14-month mortality (10%, vs 1% for the no-treatment control group participants, Figure 1;  $P = .003$ , 95% CI = 2.4–15.0%). At 14 months, 130 subjects in the experimental group and 82 in the control group remained alive and in follow-up. To evaluate whether hospitalization before study entry and baseline control-oriented strategy use could account for treatment effect, separate log rank tests of group assignment by prior hospitalization (no hospitalization vs one or more days in hospital) and by baseline high/low strategy use were conducted (Table 2). For assignment by days hospitalized, the four curves differed ( $P = .001$ ). No intervention

**Table 2. Mortality Rates by Group Assignment for Baseline Days in Hospital and Control-Oriented Strategy Use**

Baseline	Experimental	Control
	% Mortality Risk (n deaths/N)	
<b>Hospitalization*</b>		
No hospitalization	2 (2/129)	7 (6/124)
Hospitalization	0 (0/31)	21 (6/35)
<b>Control strategy use*</b>		
High strategy use	0 (0/74)	9 (5/94)
Low strategy use	3 (2/86)	11 (7/65)

Note: Survival functions for interaction of group assignment by hospitalization and control-oriented strategy use.

\*Number of days hospitalized and control-oriented strategy use 6 months before randomization.

participants with previous days hospitalized died, whereas 21% of control group counterparts did. For assignment by strategy use, the four curves also differed ( $P = .007$ ). Of high and low users of control-oriented strategies at baseline, those in the intervention group were less likely to die than those in the control group. Of intervention participants who scored low in strategy use, 3% died, compared with 11% of control participants with low strategy use. Of participants with high strategy use at baseline, 9% of control participants died, compared with 0% in the intervention group.

## DISCUSSION

The mortality effects of interventions that are designed to reduce functional difficulties and the mechanisms by which survivorship are enhanced remain unknown. This exploratory study suggests that a multicomponent intervention that introduces strategies to enhance control over daily life by modifying behavior, cognitive strategies, and the physical environment reduces mortality risk for functionally vulnerable community-living older people.

It was found that the risk of dying within 1 year after study entry was nine times higher in control group participants than in intervention group participants; for every 100 subjects enrolled, there were nine fewer deaths in the intervention group than in the control group in the first year. Although at baseline there were no differences between intervention and control group participants in background characteristics, depressed mood, health conditions, functional difficulties, social support, or home environmental conditions, those who died reported having spent more days in the hospital 6 months before study entry and lower control-oriented strategy use at baseline than those who survived. Nevertheless, hospitalization and strategy use were not confounders of the relationship between treatment effect and mortality. Rather, the intervention appears to have afforded added protection for those who were most compromised. That is, intervention participants with one or more days in the hospital before entering the study had a 21% lower risk of mortality than control group counterparts and an 8% lower risk reduction than control group participants who had not been hospitalized before study entry. Likewise, although high strategy users at baseline benefited from the intervention, those with lower strategy use scores at baseline appeared to derive greater protection than their control group counterparts.

What are the mechanisms by which the intervention might have protected against mortality for this group of functionally vulnerable older people? One explanation may be that the social contact and attention from a health professional made the difference. Participants in the control group did not receive any intervention contact; the attention from health professionals received by intervention participants may have had an important effect. Research on home visitation by nurses supports the Hawthorne explanation, but only in part.<sup>7</sup> It may be that health professionals are able to detect acute medical problems and recommend treatment for intervention subjects that in turn help to reduce mortality. Furthermore, attention alone cannot account for other gains from the intervention, such as reduced home hazards and increased control strategy use, and these

changes may in turn have had a protective effect. The intervention provided instruction in strategies that confer control over daily performance challenges and enhance performance and safety. This may support survivorship in several ways. First, previous research has shown an association between poor housing conditions of frail older people and increased mortality.<sup>17</sup> Reducing home hazards by modifying the environment (simplification or installation of grab bars) may improve housing conditions for this vulnerable group. Furthermore, research shows that self-care activities such as bathing and toileting are complex, challenging activities such that, for those performing at close to maximum capacity, even a small environmental change (grab bars) may support abilities significantly.<sup>18,19</sup> Third, reducing difficulties with mobility or bathing and toileting may have additional physiological benefits. It may increase physical actions, which in turn contribute to improved circulation to peripheral vessels and hydration, resulting in enhanced survivorship.<sup>17</sup> Finally, control-oriented strategies involve constructive problem solving and a cognitive stance that promotes engagement in other healthy behaviors such as help seeking. An important implication of this study is that older people can learn to use control-oriented strategies through a skilled intervention. As reported elsewhere, it was found that intervention participants reported greater strategy use, specifically the willingness to make home modifications, at 6 and 12 months than control participants, who reported no change in these areas.<sup>9</sup>

A potential limitation to understanding the results of this study is that cause of death was not generally known. Nevertheless, older persons tend to die from multiple factors, and the recorded cause of death may represent the end point of multiple system failures and health events.<sup>4</sup> Immediate cause of death may not be helpful in understanding the study findings. Moreover, functional difficulties are not the result of any one disease but rather the consequence of the confluence of internal (disease) and external (social and physical) environmental factors that are modifiable. Thus, minimizing such difficulties may not prevent a disease as much as the downward spiral posed by multiple factors. Another limitation may be that these were exploratory analyses and not planned as part of the original trial. Additionally, self-report versus observational measures of function were used, although there is strong evidence that self-report of function is a predictor of objective conditions, including health expenditures,<sup>20</sup> physical decline,<sup>21</sup> and comorbidities and mortality.<sup>22</sup> Moreover, perceived difficulty is an important dimension of disability and an indicator of service need and outcome. Finally, the number of deaths that occurred in the study period was modest ( $n = 14$ ) although consistent with a study sample composed of older adults with functional vulnerabilities, that is, persons with competencies intact but who are on the cusp of a downward spiral.

In conclusion, mortality is a major threat to older adults with disability imposed by chronic health problems and warrants more attention from the medical community as to effective interventions to reduce functional decline. These study results provide preliminary evidence that addressing the everyday difficulties of functionally vulnerable older people by introducing home modifications and other control-oriented strategies may reduce mortality risk. This

appears to be the case in particular for those who are most compromised, who are hospitalized, or who do not use control-oriented strategies. These strategies afford control over daily life circumstances and may protect against the deleterious consequences of functional disability by targeting modifiable behavioral, cognitive, and environmental factors that contribute to disability. This represents a novel approach and is consistent with and extends research on the protective role of positive affect and control.<sup>14,23,24</sup> Future research should evaluate whether certain intervention components afford more protection than others and the optimum number of therapy visits required to derive survivorship benefits.

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**Author Contributions:** L. Gitlin, principal investigator: developed study concept and design, oversaw scientific integrity and interpretation of data, and had primary responsibility for preparation of manuscript. W. Hauck, statistician: oversaw design development, statistical analyses, and integrity of data interpretation. L. Winter, co-project director of study: assisted in acquisition of subjects, data analysis, and manuscript preparation. M. Dennis: conducted data analysis and constructed manuscript tables. R. Schulz: provided consultation in measurement development of control index, interpretation of data, and use of Lifespan conceptual framework.

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