Variation in Response to a Home Intervention to Support Daily Function by Age, Race, Sex, and Education

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Background. Functional difficulty is associated with increased frailty and poor life quality, with the oldest old, women, African Americans, and less educated persons at greatest risk of disablement. This study examines whether these at-risk groups benefit differentially from an in-home intervention previously found to effectively reduce functional difficulties.

Methods. Three hundred nineteen community-living, functionally vulnerable adults 70 years old or older were randomized to usual care or an intervention involving occupational and physical therapy home instruction in problem solving, device use, energy conservation, safety, fall recovery, balance, and muscle strengthening. Outcome measures at 6 and 12 months included difficulty level in ambulation, instrumental (IADLs) and activities of daily living (ADLs), self-efficacy, and fear of falling.

Results. At 6 months, for ADLs, individuals ≥80 years (p = .022), women (p = .036), and less educated persons (p = .028) improved compared to their control group counterparts. For mobility, women (p = .048) and the oldest participants (p = .001) improved relative to their counterparts. For self-efficacy, women (p = .036) benefited more than men. For fear of falling, less educated persons improved more than their counterparts (p = .001). A similar pattern was found at 12 months. For IADLs, whites improved more than non-whites at 12 months.

Conclusions. Treatment benefits varied by specific participant characteristics, with individuals at greatest disability risk being most responsive to the intervention. Both white and minority participants benefited similarly except in IADL functioning. Future research should control for participant characteristics, identify underlying mechanisms for variation in treatment effects, and tailor treatment to patient characteristics and desired outcomes.

Key Words: Home modification—Disability—Frailty.

Disability resulting from chronic illness or age-related changes is associated with multiple negative consequences including a diminished quality of life, greater dependence, increased difficulties with self-care, fear of falling, greater risk of falls, and higher service utilization and costs, nursing home placement, and mortality (1,2). Previous research consistently shows that older adults at risk of disability are older, women, minority group members (particularly African Americans), and individuals with low socioeconomic status (3,4). Although prior intervention studies to address functional decline report small positive gains (5–10), the responsiveness to interventions by elders at greatest risk of disablement has not been evaluated. Thus, it is unknown whether treatment outcomes vary by specific demographic characteristics. Given the extensive research documenting different prevalence rates of disability for demographic profiles (11–14), it is important to examine whether factors such as age, sex, education, and race influence responses to interventions. Specifying for whom an intervention works best and in what functional areas helps to inform future intervention studies and the clinical populations most likely to benefit (7,8,15–17). Furthermore, identifying variations in treatment response or moderators of outcomes leads to a more nuanced understanding of intervention effects and generates specific hypotheses for future testing in randomized trials.

The purpose of this study was to examine whether specific demographic groups benefited more from participating in a 6-month intervention that was previously found to reduce functional difficulties and fear of falling and enhance self-efficacy in the overall sample (18,19). We evaluated whether older versus younger, non-white versus white, women versus men, and individuals with low versus high education were more likely to benefit from the intervention.

Methods

Study Sample and Procedures

All study procedures including CONSORT flow chart, recruitment, and randomization were reported elsewhere (18,19). Briefly, participants were recruited between 2000 and 2003 from social services and media announcements. Study participants were 70 years old or older, cognitively intact (Mini-Mental State Examination [MMSE] score > 23 on a 0–30 scale; 20), and English speaking, and they had functional difficulties for which they were not receiving home care services.

Institutional Review Board–approved informed consent was obtained, and a baseline home interview was conducted. Participants were then randomized to intervention or no-
treatment control, and re-interviewed at 6 (main study endpoint) and 12 months by trained interviewers masked to group assignment. Of the 319 participants ($n = 159$ control, $n = 160$ experimental) enrolled, $300 (94\%)$ were available at 6 months and $285 (89\%)$ at 12 months. Of 34 participants lost to 12-month follow-up, 14 died, 1 was hospitalized, 4 were dissatisfied with the study, 5 entered nursing homes, 8 were unable to be located, and 2 had significantly deteriorating health. There were no large or statistically significant differences between intervention and control group participants on demographic and outcome variables at baseline (17).

**Intervention Group**

The intervention addressed functional decline by providing strategies to compensate for disparities between a person’s ability and environmental demands. Participants received five contacts with occupational therapists (OT) (four 90-minute home visits and one 20-minute telephone contact) involving education, problem-solving, home modification, and energy conservation training and one contact with a physical therapist (PT) (90 minutes) involving balance and muscle strength training and safe fall and fall recovery techniques. Home modifications (grab bars, rails, seating adaptations, transfer devices) were provided free of charge through grant funds when needed. Over the subsequent 6 months, participants received three brief telephone calls from OTs to reinforce strategy use and help generalize use to new performance difficulties. A final OT visit at 10 months obtained intervention closure. Control group participants did not receive any intervention contact and at 12 months received home safety materials.

**Outcomes**

**Functional difficulty.—**Study participants were interviewed at home using a standard self-report measure of difficulties in 17 areas (Cronbach $a = .70$ for this sample) including 6 instrumental activities of daily living (IADLs) (light housework, shopping, preparing meals, managing money, telephone use, and taking medications; 21), six ADLs (dressing above waist, dressing below waist, grooming, bathing/showering, toileting, and feeding), and six mobility/transferring items (getting into/out of car, walking indoors, walking one block, climbing one flight of stairs, getting into/out of a chair, and moving in/out of bed). For each item, participants rated difficulty level in the past month from 1 ("no difficulty") to 5 ("unable to do due to health problems"), with higher scores indicating greater difficulty (22). Three indices were created by calculating mean difficulty across respective items.

**Self-efficacy.—**Self-efficacy refers to an assessment of one’s ability to perform an activity and achieve a desired outcome (23). Participants rated self-efficacy or confidence managing difficulties performing 17 tasks (IADLs, ADLs, and mobility), from 1 ("Not at all confident") to 5 ("Very confident"). The Self-efficacy Index represents mean perceived confidence, with higher scores indicating greater confidence (Cronbach $a = .92$ for this sample).

**Fear of falling.—**Fear of falling was assessed using the 10-item Falls Efficacy Scale from Tinetti and colleagues (24) and three items from the Activities-specific Balance Confidence Scale (confidence in ability to walk up or down stairs, bend over and pick up a slipper from floor, and get into or out of a car without falling) from Powell and Myers (25). On 10-point scales, participants rated their level of confidence in performing these 13 self-care tasks without falling. Items were reverse coded to reflect a positive valence, with higher scores indicating greater perceived confidence in one’s ability to carry out daily activities without falling, or falls efficacy. Scores were averaged across the 13 items (Cronbach $\alpha = .93$ for this sample).

**Statistical Analysis**

Chi-square and Wilcoxon rank-sum tests were used to compare participants by gender, race, age, and education on each outcome measure at baseline. Means, standard deviations (SD), and ranges for each outcome measure were computed.

To examine variation in treatment response at 6 and 12 months, analyses of covariance (ANCOVA) were conducted for each of the five main outcomes (ADL, IADL, mobility difficulties, self-efficacy, and fear of falling) using the 6- and 12-month scores. For each analysis, we introduced an interaction term between group assignment and one of the four demographic characteristics (age, gender, race, and education level). To examine interaction effects for treatment by age, we split the sample into two groups to compare the oldest elders ($\geq 80$) to younger elders ($< 80$) for several reasons. The gerontological literature consistently shows significant age group differences along health and functional parameters, although the specific age cutoff varies between 80 and 85 years. Because 80 reflected the mean age for our sample, we used this age to divide our sample into young versus old participants (13,26,27). To examine interaction effects for education, we split the sample into three groups: less than high school education, completion of high school, and education beyond high school. For race analyses, we examined whites versus non-whites.

Covariates used in each analysis reflected design variables (race, living arrangement), baseline value of the outcome measure, and other baseline factors shown in previous research to be associated with functional difficulty (age, financial difficulty, social support, depressive symptoms) (28).

The distribution of residuals was somewhat skewed for ADL difficulty but neither a log nor square root transformation improved the distribution; thus, we report the nontransformed distribution. SPSS version 14.0 (Chicago, IL) was used with significance level set at .05. All analyses were two-sided and followed an intention-to-treat model such that all participants providing data were included in the analyses regardless of participation level.

**RESULTS**

**Sample Characteristics**

Participants had a mean age of 79, were primarily female (82%), lived alone (62%), and had a high school or greater...
Table 1. Interaction Effects for Treatment by Demographic Characteristics at 6 and 12 Months

<table>
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<tr>
<th>Dependent Variable</th>
<th>Interaction</th>
<th>Adjusted Treatment Effect at 6 Months</th>
<th>Estimate</th>
<th>95% CI</th>
<th>p</th>
<th>Adjusted Treatment Effect at 12 Months</th>
<th>Estimate</th>
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<th>p</th>
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<td>0.29</td>
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Note: * ADL difficulty*, IADL difficulty*, and Self-efficacy* are interaction effects.
education. The majority were white (53%), and 46% were African American. Participants reported an average of seven health conditions, “some” to “a lot of difficulty” with mobility (mean = 2.5, SD = .8), ADLs (mean = 1.8, SD = .6), and IADLs (mean = 2.0, SD = .6), with 70% rating their health as fair to poor.

There were no meaningful or statistically significant differences in demographic characteristics between treatment groups at baseline. Additionally, there were no meaningful or statistically significant differences between men and women; whites and non-whites; those with low, medium, or high education; or younger and older adults on baseline outcome measures, except in one area: African-American elders reported slightly greater functional difficulties than whites reporting less IADL difficulty than non-whites. Thus, with this exception, these demographically defined groups enrolled in the study with similar average need levels.

**ADL Difficulties**

At 6 months, we found that sex (p = .036), age (p = .022), and education (p = .028) (but not race) moderated treatment outcomes (Table 1), with women, the oldest old (>80 years), and those with less education (less than high school education) reporting lower levels of ADL difficulties and thus benefiting from the intervention more so than their counterparts. We also entered all three interactions into one model to evaluate whether they remained independent contributors (data not shown) and found that two interactions, Treatment × Age (p = .041) and Treatment × Sex (p = .035) retained their significance. By contrast, Treatment × Education remained large in magnitude but was no longer statistically significant (p = .061). At 12 months, only the Treatment × Age interaction remained statistically significant. Although the magnitude of effect for those with less education was similar to that at 6 months, it was not statistically significant. For sex, there were no differential benefits at 12 months.

**Mobility Difficulties**

At 6 months, we found statistically significant interaction effects for treatment by sex (p = .048) and by age (p = .001), but not by education or race (Table 1). Women in the intervention group showed a statistically significant decrease in mobility difficulties compared to men. To evaluate whether interaction effects for women and participants 80+ years old were independent of each other, we entered these two interactions into one model. We found that they both retained statistical significance (Treatment × Sex, p = .043; Treatment × Age, p = .000). At 12 months, the Treatment × Age interaction remained statistically significant (p = .007), whereas the Treatment × Sex interaction was not statistically significant and Treatment × Education interaction obtained statistical significance (p = .009).

**IADL Difficulties**

At 6 months, estimates of interaction effects of intervention by sex, age, race, and education for IADL difficulty were not statistically significant (Table 1). At 12 months, Treatment × Race reached statistical significance (p = .028), with whites reporting less IADL difficulty than non-whites.

**Self-Efficacy**

At 6 months, we found a statistically significant interaction effect for Treatment × Sex only, with women demonstrating greater self-efficacy than men (p = .036). At 12 months, Treatment × Age (p = .030) and Education
(p = .016) reached statistical significance, with older and less educated participants reporting greater self-efficacy than their counterparts.

**Fear of Falling**

The only interaction that reached statistical significance was Treatment × Education at 6 months. Less educated intervention participants reported less fear of falling than did individuals with high school or greater education.

**DISCUSSION**

This study shows variations in response to an at-home intervention by demographic characteristics. Women, individuals 80 years old or older, and those with less education appeared to benefit more than their counterparts at 6 months in specific functional domains, with similar patterns found at 12 months. Although previous research has consistently shown differences in function for demographic profiles, this study extends knowledge by showing that differences apply as well to treatment responses. Furthermore, we found that the groups shown in previous research to be at greatest risk of functional impairment are the ones that benefited the most.

The question remains as to why variations in response to the intervention occur. At study entry, all groups started the trial at similar levels of need for each of the five outcome variables except in one area. As reported elsewhere, African-American elders reported slightly greater functional difficulties than whites did (29). Thus, the observed differences in treatment responses did not reflect greater baseline need. Also, when each statistically significant interaction was entered simultaneously into one model for ADL and one model for mobility difficulty, each interaction retained its importance as a predictor, although one, Treatment × Education for ADL difficulties, was no longer statistically significant (p = .061). Because the interactions are independent contributors, there is no underlying common explanatory factor that can account for the variations in the observed treatment responses.

The differences found between men and women are consistent with intervention studies of other clinical populations (6,30). For example, our research on a home program for dementia caregivers using problem solving and environmental strategies showed that women improved more than men in skill acquisition and subjective well-being (31). It may be that women are more responsive to this type of intervention because they match their approach to solving health care problems through help seeking and use of different strategies. Additionally, previous research shows that men tend to underreport their disability, suggesting that a positive change as a consequence of the intervention may not have been detected (14). Future research should consider why men benefit in some areas and not others and what factors may account for these treatment differences.

As to age, the findings suggest that older age groups can learn new ways of managing ADL and mobility-related tasks and that this benefit persists over time. These findings are noteworthy in that functional difficulties in these areas are associated with negative sequelae including depression, reduced quality of life, risk of relocation, increased health care resource utilization, and frailty (32). At 12 months, the older group also reported greater confidence managing functional difficulties suggesting that self-efficacy improved with time. One explanation may be that the older group had more exposure to managing chronic functional limitations on their own and, consequently, were more accepting of and inclined to use prescribed compensatory strategies, resulting in functional improvements. If this is the case, interventions should be designed differently for individuals with recent onset of functional decline or those with less experience managing such difficulties. A question for future research is whether readiness to use prescribed strategies mediates intervention outcomes for different age groups. An alternate explanation is that, in comparison to the younger age group, the older group may have had less access to information about concrete strategies for managing functional difficulties and thus derived greater benefit from the intervention.

Consistent with other intervention studies with different clinical populations, individuals with lower education did better in ADL and mobility-related difficulties and two areas of self-efficacy, feeling confident in managing functional difficulties day-to-day and performing daily tasks without falling (33). One explanation may be that older adults with low education have fewer resources, less access to health care or other resources such as assistive devices, and less knowledge of specific compensatory strategies to address functional concerns (12,13). We did not find that treatment effects differed by race except for IADL difficulties at 12 months, with whites appearing to perform slightly better in this area than minority participants, the majority of whom were African American. Thus, the intervention appeared to work similarly for both groups at both time points for other treatment outcomes. This may be due to the focus of the intervention on personal goal identification and introduction of strategies that are tailored to the individual’s environmental context and personal preferences such that the therapeutic approach resonates with individuals from diverse backgrounds and cultures.

Although small treatment effects for most outcomes may call into question their clinical significance, this is consistent with the findings from other functional intervention studies (8). Moreover, recent research shows that older people perform self-care at close to their maximum capacity such that even small health declines contribute to disablement. This suggests that any reduction in performance difficulties may be clinically meaningful (2). Furthermore, as we have reported elsewhere, we found that intervention participants had a survivorship benefit suggesting that the small changes we found in difficulty levels were clinically significant (19).

**Summary**

We found differential effects of the intervention by age, sex, and education. These differences suggest hypotheses for future research in this area as discussed above. The good news is that persons most vulnerable to functional decline appear to benefit the most. Nevertheless, treatment responses were not uniform across outcomes, making the picture complex. The challenge for future research will be to match interventions with specific participant characteristics and to
test adjustments to interventions to address needs of groups less likely to benefit, such as men or African Americans with IADL difficulties. Of equal importance will be to examine treatment characteristics (dose, intensity) and other factors such as self-efficacy as potential mediators to explain the underlying mechanisms for how and why treatment benefits are achieved in certain groups and not for others. Finally, these findings suggest the importance of future intervention studies to include demographic characteristics as stratification variables to formally test variations in treatment response and evaluate the generalizability of these findings.

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