Development and evaluation of community-clinical linkages between physical therapy clinics and EnhanceFitness, an evidence-based physical activity program for older adults

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Abstract

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Background: Many barriers exist to older adult participation in physical activity (PA), despite known benefits. Enhance®Fitness (EF) is a nationally-disseminated evidence-based group exercise program for older adults. Clinical-community linkages (CCL) are partnerships between clinical entities and community-based health promotion organizations. Referrals from physical therapists (PTs) through clinical-community linkages offer novel, promising opportunities to increase older adult engagement in appropriate community-based PA programs.

Methods: In Chapter 2, we examined changes in, and predictors of, participant physical function as measured by three tests. We analyzed EF participant data (n=6,442) collected longitudinally in

16-week program cycles using random effects linear regressions for each physical function test: arm curls, chair stands, and eight-foot up-and-go.

In Chapter 3, we assessed the capacity of PTs to participate in such linkages. We collected qualitative data from April to July of 2015 via structured direct observations (n=39) in five Seattle-area PT clinics, and semi-structured phone interviews (n=30) with PTs across 14 states. We conducted thematic analysis using *a priori* themes based on the Etz et al. (2008) Bridging Model: capacity to assess patient risk, ability to provide brief counseling, capacity and ability to refer, and awareness of community resources.

In Chapter 4, we conducted a comprehensive literature review to identify content areas and existing instruments; developed new items and modified content and design of existing items; and assessed content validity with review from three expert panels. We conducted 10 cognitive interviews to assess face validity, and tested construct validity using known group validation with participants from an ongoing CCL focused research project.

Results:

In Chapter 2, we found attendance predicted clinically significant improvements in all three physical function tests. Less improvement was associated with being female, less active at baseline, above age 75, not married or partnered, in fair or poor health, and having a disability.

In Chapter 3, results show that PT assessment of risk is integrated in practice, and referrals to physical activity programs in the community may be facilitated by the intensity of PT sessions and focus on benefits of exercise. However, such referrals are hampered by a lack of program knowledge, concerns about program safety, and lack of communication systems.

Successful partnerships may need to be initiated by community programs, and begin at the clinic level.

In Chapter 4, feedback from experts and cognitive interviews included framing the survey as an actionable self-assessment. They provided guidance on language and scoring format. The final instrument includes 15 items across 5 survey domains. The survey overall and three domains (Communication, Referral Process, Feedback) showed construct validity, and a fourth domain (Nature of Organizational Relationship) approached significance. The final domain (Timeliness) did not demonstrate construct validity.

<u>Discussion:</u>

In Chapter 2, results demonstrate sustained, significant improvements in a population that often faces functional decline. We identify groups at risk of fewer gains. Implications for program delivery include targeting messaging to motivate attendance and general activity, and providing additional support for these groups during EF classes.

In Chapter 3, we found PTs have potential to create partnerships with PA programs due to understanding of a patient's physical abilities, patient rapport, and partnership buy-in. Targeting evidence-based programs capable of continuing therapy gains could improve partnership capacity. Systemic improvements include implementing communication system innovations and partnership activities that facilitate referral processes and increase knowledge/trust in community programs.

In Chapter 4, The newly developed Clinical-Community Linkage Self-Assessment Survey may be a useful tool for assessing the strength of clinical-community linkages from the perspective of a community organization. It is important to stakeholders, and meets their criteria of being brief, accessible, and pragmatic. Additional validity testing is needed with a larger sample, and from a clinic perspective. An important addition is the development and testing of an accompanying Recommended Action Guide that maps directly to the self-assessment, and provides step-by-step guidance.

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DEDICATION

For my family.

Chapter 1. INTRODUCTION

1.1 Older Adults and Physical Activity

Older adults are the fastest-growing, least physically active demographic group in the US, and produce the highest medical costs (Nelson et al., 2007). Physical activity has been shown to reduce costs (Carlson, Fulton, Pratt, Yang, & Adams, 2015; Penninx et al., 2001) and improve many health-related outcomes that are of particular importance to older adults. These include the ability to maintain independent living (Nelson et al., 2007; Warburton, Nicol, & Bredin, 2006) through restored balance, increased strength, reduced limitations in functional abilities, and ameliorated effects of chronic conditions (Boyle, Buchman, Wilson, Bienias, & Bennett, 2007; Gill et al., 2004; Liu & Latham, 2009). However, less than a third of older adults in the US participate in adequate physical activity (Nelson et al., 2007; Sun, Norman, & While, 2013).

EnhanceFitness (EF) is a low-cost, evidence-based, group physical activity program targeted to older adults that is accessible to multiple levels of function, shown to reduce long-term medical expenses, and improve key areas of health and wellbeing (Agmon, Kelly, Logsdon, Nguyen, & Belza, 2015; Belza et al., 2006; Wallace et al., 1998). Attending for one week provides the required aerobic and muscle strengthening activity to meet the CDC recommended weekly activity level (150 minutes of moderate, or 75 minutes of vigorous aerobic activity; coupled with muscle strengthening two days a week).

One mechanism to increase physical activity for older adults is behavioral counseling (Buckley et al., 2015; Dymek et al., 2015). Unfortunately, restricted resources, lack of training, and insufficient time to establish new systems are a few of the challenges that hinder the implementation of existing, evidence-based health guidelines like behavioral counseling (Cohen, Tallia, Crabtree, & Young, 2005; Health & Center for the Advancement of Health, 2001; Stange, Woolf, & Gjeltema, 2002).

1.2 Clinical-Community Linkages

Research has repeatedly shown the value of clinical-community linkages to resolve barriers to implementing health guidelines (Epping-Jordan, Pruitt, Bengoa, & Wagner, 2004; Public Health Foundation, 2004), and dramatically increase health behaviors and population health (Buckley et al., 2015; Dymek et al., 2015). Clinical-community linkages are partnerships that bridge clinical entities with community-based health promotion practitioners (Barr et al., 2003) to improve patient access to preventive services (Dymek et al., 2015). These linkages aim to coordinate care delivery with public health and community activities to promote healthy behavior, and cultivate partnerships among organizations from multiple sectors that fill gaps in services (Buckley et al., 2015; Dymek et al., 2015). The Agency for Healthcare Research and Quality (AHRQ) provides as an example the “King County Steps to Health” linkage, which used community health workers as liaisons among clinic/clinicians, patients, and community resources in order to foster referrals to community resources for various health promotion services. Evidence of success included improved healthy behaviors (e.g., increased levels of physical activity), asthma and diabetes outcomes (Dymek et al., 2015). However, specific criteria are lacking to guide the initial development, and subsequent evaluation of linkages (Etz et al., 2008). Measuring and tracking linkages is necessary to empirically assess if they adequately fill the needs of the patient, and satisfactorily deliver the preventive or health promotion service.

The Agency for Healthcare Research and Quality (AHRQ) provides one of the few conceptual frameworks to categorize and measure linkages. AHRQ’s Clinical-Community

Relationships Measures (CCRM) Atlas (Dymek et al., 2015) identifies three distinct elements of clinical-community linkages (the clinic, the resource, and their relationship). It applies Donabedian's structure-process-outcome model (Donabedian, 1988) to create specific measurement domains for each element. However, few measures exist, and those that do are excerpted from larger instruments intended for other purposes (Buckley et al., 2015; Dymek et al., 2015).

1.3 The Physical Therapy Setting

A largely untapped, yet promising opportunity to build clinical-community linkages with physical activity programs is in the physical therapy (PT) setting. Because of the duration and intensity of their appointments, PTs have time to offer high-intensity behavioral counseling (i.e., multiple contacts over extended periods totaling at least 31 minutes) that has been shown to be more effective in changing patient physical activity adherence (US Preventive Services Task Force, 2016). Further, the specific treatment goals of physical therapy are similar to those of exercise programs. These include the focus on strength, balance, flexibility, and management of pain or chronic conditions (Ohtake, 2010).

1.4 **Gaps in Knowledge**

This dissertation will fill three primary gaps in knowledge. First, although there is evidence that suggests EF can help improve functional performance outcomes (Agmon et al., 2015; Belza et al., 2006; Wallace et al., 1998), there is no research that specifically examines predictors of physical function improvement across demographic groups and health conditions.

This is an important consideration, as it can help identify groups with more underlying barriers, inform program delivery to best support all participants, and guide program messaging to expand reach.

Second, little is known about the capacity of PTs to participate in clinical-community linkages. Behavioral counseling may be more effective in the PT setting to increase physical activity through referrals to community-based physical activity programs like EF. To the knowledge of the researcher, none of the sparse clinical-community linkages literature includes physical therapists.

Last, while research has repeatedly shown the potential of clinical-community linkages to increase preventive health behaviors (Epping-Jordan et al., 2004) there are few guidelines on how to evaluate these linkages (Dymek et al., 2015). A dearth of supporting literature highlights the need for accessible information and metrics to assess partnerships between clinical entities and community organizations.

1.5 Purpose and Approach

The purposes of this dissertation are to address these gaps by 1) identifying participant-level predictors of EF program efficacy, 2) assessing the capacity of physical therapists to participate in linkages, and 3) developing instruments by which to evaluate clinical-community linkages more broadly. We address these purposes through each of the following three Aims, respectively.

In Aim 1, we evaluate the improvements in physical function resulting from attendance of the EF program, and identify participants at risk of achieving the smallest gains. We examine the association of three measures of physical function with EF attendance and participant-level characteristics across two EF program cycles (8 months). We found attendance predicted clinically significant improvements in all three physical function tests. Lower improvement among participants was associated with being female, less active at baseline, above age 75, not married or partnered, in fair or poor health, and having a disability. The results of this study add to the evidence base of the EF program, and fill literature gaps related to participant-level predictors of lower improvement in physical function.

In Aim 2, we assess the capacity, and identify next steps, to improve the capacity of PTs to develop clinical-community linkages with programs like EF. In this study, we use the term clinical-community linkages to describe relationship that provided referrals from physical therapists to community-based physical activity programs. Results show that PT assessment of risk is integrated in practice, and referrals to physical activity programs in the community may be facilitated by the intensity of PT sessions and the focus on exercise benefits. However, such referrals are hampered by a lack of program knowledge, concerns about program safety, and lack of communication systems. Successful partnerships may need to be initiated by community programs, and begin at the clinic level.

In Aim 3, we describe the development and testing of an instrument to evaluate clinical-community linkages from the perspective of community organizations. In this study, we also focus on linkages that involve referrals. Feedback from experts and cognitive interviews included framing the survey as an actionable self-assessment. They also provided guidance on language, and scoring format. The final instrument includes 15 items across 5 survey domains. The survey overall, and three domains (Communication, Referral Process, Feedback), demonstrated construct validity, and a fourth domain (Nature of Organizational Relationship) approached significance in the analysis. The final domain (Timeliness) did not demonstrate construct validity. Although further testing is needed, this instrument may provide a needed resource to evaluate linkages in many settings, and fill gaps of the CCRM Atlas.

We conclude with a discussion of the larger implications of this dissertation. EnhanceFitness programs could target messages to motivate attendance and general activity, offer additional support to at-risk groups during EF classes, and help participants understand how test days can provide valuable feedback about their functional changes. PTs may also integrate motivational techniques, innovations in communication infrastructure, increase linkage activities and outreach from evidence-based exercise programs. We help fill the scarcity of resources supporting clinical-community linkages by providing an instrument for linkage evaluation. After further validation, our instrument may ultimately help community organizations identify strengths and barriers in their clinical partnerships, and guide action in building these relationships. Future research could refocus the instrument for clinical settings, and conduct additional validation. Next steps include designing and testing a guide that provides step-by step actions based on the results of the self-assessment.

Chapter 2. PREDICTORS OF IMPROVEMENT IN PHYSICAL FUNCTION IN OLDER ADULTS IN AN EVIDENCE-BASED PHYSICAL ACTIVITY PROGRAM (ENHANCEFITNESS)

2.1 INTRODUCTION

Some health conditions, as well as aging, are associated with a decline in physical function (Lee, 2000). Engaging in multiple types of physical activity (i.e., strength, aerobic, balance) can help older adults retain balance, strength, and physical function (Boyle et al., 2007; Gill et al., 2004; Liu & Latham, 2009), thereby preserving independence through the ability to perform activities of daily living (e.g., bathing, dressing, using a toilet, and eating) (Carlson et al., 2015; Nelson et al., 2007; Penninx et al., 2001; Warburton et al., 2006). Community-based exercise programs help older adults reach recommended physical activity levels (Boutaugh, 2003; Centers for Disease Control and Prevention, 2008; Farrance, Tsofliou, & Clark, 2016). Unfortunately, engaging in physical activity cannot always prevent declining physical function for older adults in the worst health (de Labra, Guimaraes-Pinheiro, Maseda, Lorenzo, & Millán-Calenti, 2015; Giné-Garriga, Roqué-Fíguls, Coll-Planas, Sitjà-Rabert, & Salvà, 2014). It is important to identify groups with less improvement to know where to target additional support for those with the most to gain from physical activity.

2.1.1.1 The Enhance®Fitness Program

Enhance®Fitness (EF) is an evidence-based, low-cost, community group exercise program for older adults (aged 65 and above), accessible at multiple levels of health and function (Wallace et al., 1998). Attending the program for one week provides enough physical activity to meet the CDC-recommended weekly levels for older adults (i.e., 150 minutes of moderate or 75 minutes vigorous intensity aerobic activity, and 2 days of muscle strengthening) (Centers for Disease Control and Prevention, 2008). EF improves physical function (Agmon et al., 2015; Belza et al., 2006; Belza, Snyder, Thompson, & LoGerfo, 2010; Kohn, Belza, Petrescu-Prahova, & Miyawaki, 2016), which enables independent living. The program is available nationally, with 680 current sites in 40 states across the U.S. (SoundGenerations, 2017).

EF participants identified social connection and improved general health as motivators to attendance, and identified some health conditions (e.g., pain and arthritis) as barriers (Chiang, Seman, Belza, & Hsin-Chun Tsai, 2008; Kohn et al., 2016). Although improved health is an important motivator for sustained participation in EF, not all groups experience equal gains in physical function. However, little outside research, and no EF research, exists that specifically examines predictors of physical function improvement across demographics and health conditions.

2.1.1.2 The Current Study

This study evaluates group differences in physical function improvements resulting from EF program attendance. We examine the association between physical function, with EF attendance and participant-level characteristics. This study adds to the evidence about the EF program, and fills gaps in knowledge by identifying participants at risk of achieving smaller gains.

2.2 METHODS

2.2.1 *Intervention*

The EF program provides multiple types of physical activity in a structured format. Classes meet for 60 minutes, three times a week and are taught by certified instructors. Most classes are taught on an ongoing basis, but some are offered in 16-week increments (hereafter referred to as a "program cycle"). Classes include cardiovascular, strength, flexibility and balance exercises. Exercises may be done sitting, standing, or standing with support. The program measures three areas of physical function, each via its own test: upper-extremity strength (measured by arm curls), lower-extremity strength (measured by chair stands) and balance (measured by eight-foot up-and-go) (Rikli & Jones, 1999a). Physical function tests are performed at enrollment and after the first program cycle (4 months, or 48 total classes). About 85% conduct an additional physical function test after the second program cycle (8 months, 96 total classes).

2.2.2 *Study Design and Dataset*

The dataset consists of regularly collected EF program data from January 2005 to June 2016. Certified EF program instructors collect participant data, and it is entered into an online database, the Online Data Entry System or ODES. The ODES is maintained by the licensor of EF, Sound Generations, a non-profit social services organization in Seattle, WA. Demographic variables are collected at baseline, and attendance is logged every session.

Our exclusion criteria addressed several issues in the dataset. The initial dataset had 25,584 participants. We excluded participants who did not have any follow up data after baseline (n=14,050). There was extreme variation in the time between the first and second physical function tests, ranging from 4 weeks to 11 years. Therefore, we excluded participants whose second physical function test was extremely deviant from the EF-defined program cycle (n=5,093). Deviancy was based on the distribution of the sample, and equated to less than 10 and more than 22 weeks. Last, because there was a large drop in attendance after the second program cycle, we included only the first three sets of physical function tests (i.e., participants in the sample had at least a test at baseline and the first program cycle, but may have had three test scores). The final sample includes 6,442 participants. We compared the final sample to the excluded participants using logistic regression. We found significant, but weak (OR<1.1) associations between being in the final sample, and not being disabled, being more active, and in better health. We found a stronger association (OR: 2.4) with Asian race (see below for description of variables). This analysis uses fully de-identified secondary data and was classified as exempt by our institutional review board.

2.2.3 ***Variables of Interest***

2.2.3.1 Physical Function

The EF program uses an adapted version of the Functional Fitness Test, a validated measure of three types of physical function: upper extremity strength, lower extremity strength and balance and mobility. Content validity was established using literature review and expert opinion; each test has demonstrated test-retest reliability; and all tests are able to discriminate between regular exercisers and non-exercisers (Rikli & Jones, 1999a).

Upper Extremity Strength (Measured by Arm Curls). The number of times a weight can be lifted in a 30-second time period. Women use a 5-lb weight, while men use an 8-lb weight.

Higher counts indicate greater physical function.

Lower Extremity Strength (Measured by Thirty-Second Chair Stands). Participants are asked to stand up and sit down without using their arms from a 17-inch tall chair, as many times as possible in 30 seconds. Higher counts indicate greater physical function.

Balance and Mobility (Measured by Eight-Foot Up-and-Go). Participants are asked to stand up from a 17-inch-tall chair, walk as quickly as they can for 8 feet, turn, walk back, and sit back down in the chair. Times are measured in seconds and rounded to one decimal place. Lower second counts (i.e., faster times) indicate higher physical function.

A subsequent nationwide study established normative physical performance scores in the Functional Fitness Test (Rikli & Jones, 1999b). Normal scores were generated separately for each gender and 5-year age interval, and defined by the middle 50% of the study population. Those scoring above this range would be considered above average for their age, and those below the range as below average (Jones & Rikli, 2002; Rikli & Jones, 1999b). We discuss normative age and sex ranges for the data descriptively in the results and discussion sections, however the analysis uses the raw function test scores for precision and power.

2.2.3.2 Attendance Variable

Weeks attended. We divided the total count of attendance in each program cycle by three, which represents the number of sessions available per week. Therefore, this variable represents the number of weeks of attendance in the previous program cycle, and the number of weeks the participant met recommended physical-activity levels. This enabled us to match the per-week format of the CDC physical-activity recommendation and gain more meaningful coefficients in the model.

2.2.3.3 Demographic Variables

Demographic variables include age (years), gender (male, female), race (White, Black/African-American, American Indian/Alaska Native, Asian, Hawaiian Native/Pacific Islander, two or more races), ethnicity (Hispanic, not Hispanic), and marital status (married/partnered, other).

2.2.3.4 Health Status Variables

Self-reported comorbidities. A checklist of six conditions asking, "Have you ever been told by a doctor or other health professional that you have any of the following conditions? Mark all that apply." Options include: hypertension/heart disease, arthritis/rheumatic disease, diabetes/pre-diabetes, asthma/lung disease, depression, cancer.

Disability. This item asked, "Do you consider yourself to be a person with a disability?" Answer options are disabled or not disabled.

Overall health. The single-question SF-1 asks participants to rate their self-reported general health on a 5-point scale from poor to excellent. For this analysis, results were dichotomized at the frequently used cut-point: Poor or Fair versus Good to Excellent (Zajacova & Dowd, 2011).

Number of physically active days. Single question gathered at baseline and asking, "Including the days that you go to EnhanceFitness class, how many days per week do you do physical activity that is about as hard as EnhanceFitness exercises, for 30 minutes or more?" Response choices are dichotomized at 0-3, or 4 and above.

Number of falls. Self-reported number of falls in the 4 months prior to the test, gathered at baseline (zero falls, one or more falls).

2.2.4 ***Data Analysis Strategy***

We examined the relationship of physical function test score with program attendance and participant-level predictors in each completed program cycle using three longitudinal random effects linear regression models. We controlled for baseline test performance, and test specifications (i.e., weight used for arm curls, assistive device used for walking). We conduced all analyses in STATA 13.1.

Our models account for intragroup correlation, missing data, and were as parsimonious as possible. We used random intercepts for EF sites (n=556). To account for unreported data without losing power, we used indicator variables for missingness in unordered categorical predictors. This method is a simple and useful approach to imputation (Gelman & Hill, 2007), and because our sample is a relatively homogenous group (older adult exercise program participants) there are likely common reasons for missing data.

There were two variables that were not significant in any model (education, and whether a disability limited one's activities). In sensitivity analyses, we compared model results with and without the missing indicator categories and non-significant variables. There were no meaningful differences in the results. We dropped non-significant variables, and present the final model in the Results below.

2.3 RESULTS

2.3.1 ***Study Sample***

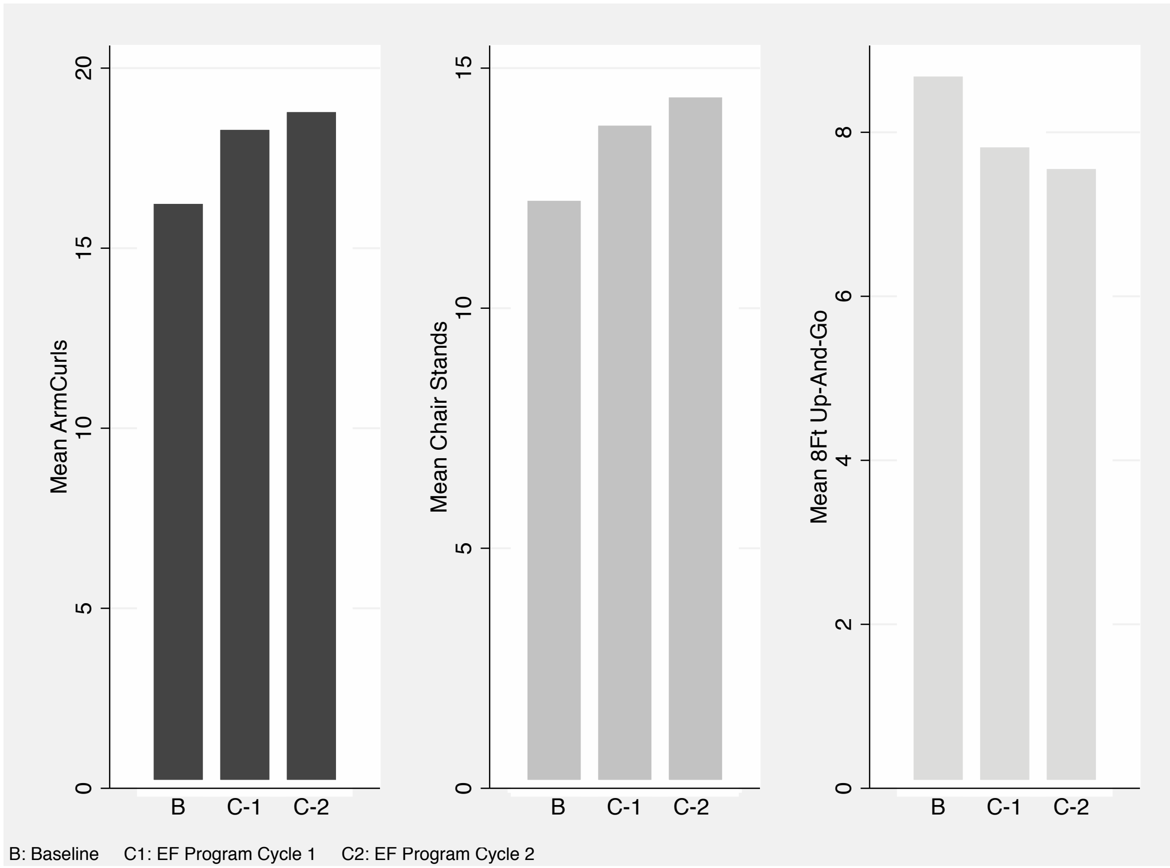
The 6,442 sample participants (Table 1) were mostly between the ages of 65 and 75 years (53%), female (81%), and white (62%); 46% were not married or partnered. Most did not have a disability (63%), were in at least good health (83%), and had not experienced any falls (70%). The mean attendance for the first program cycle, and the physical function test scores for baseline and first follow-up are presented by demographic (Table 2).

2.3.1.1 Overall Trend of Physical Function

The mean performance on the physical function tests at baseline was 16.5 arm curls, of which 48% were in the normal range for their age-sex category (Rikli & Jones, 1999b); 12.4 chair stands (58% in normal range), and 8.8 seconds for the eight-foot up-and-go (41% in normal range) (Table 3). The mean number of weeks of EF attended in the first program cycle was 11.5. These data show statistically significant improvement in all three tests from baseline to first follow-up, and then from first follow-up to second follow-up (Figure 1). Normative data show shifts to higher-performing categories in all physical function tests. For example, from baseline to the first program cycle (4 months) for arm curls, the number of people in the below normal category shrank from 14% (n=902) to 7% (n=480), those in the normal category shrank from 48% (n=3,111) to 39% (n=2,530); while those in the above normal grew from 34% (n=2,204) to 50% (n=3,226).

Every additional week of EF class attendance per program cycle was significantly associated with an increase in upper extremity strength (0.15 arm curls, $p<.001$), lower extremity strength (0.12 chair stands, $p<.001$) and improved balance (0.07 second reduction in time for the eight-foot up-and-go, $p<.001$) (Table 4).

Figure 2.1. *Mean Physical Function Test After Each EF Program Cycle Among Participants Enrolled 2005-2016*



Improvement in arm curls and chair stands is indicated with higher scores. Improvement in 8-ft up and go is indicated with lower times.

2.3.2 *Association of Physical Function with Person-level Predictors*

Significant associations between each physical function test (which were the dependent variables in three different regression models that included attendance) and person-level predictors are presented below. We focus on those that are significantly associated in the same direction with at least two of the three physical function tests (Table 4).

2.3.2.1 Characteristics Associated with Poorer Physical Function

The highest associations with physical function included: being above 85 (as compared to 65-75); being in fair or poor health; and having a disability. All three were associated with less upper body strength, less lower body strength, and worse balance.

Not being partnered or married (as compared to being partnered) was associated with less upper body strength (i.e., fewer arm curls), less lower body strength (i.e., fewer chair stands), and less balance and mobility (i.e., more seconds on the eight-foot up and go) per program cycle. Being female (as compared to male) was associated with less upper body strength and less lower body strength. Being 75-85 (as compared to 65-75) was associated with less upper body strength, less lower body strength, and less balance. Having less than four physically active days a week was associated with less lower body strength, and less balance.

2.4 DISCUSSION

In summary, EF participants showed statistically and clinically significant improvements in physical function, as measured by upper and lower extremity strength and balance, after both the first and second 4-month program cycles. Lower improvement was associated with being female, less active at baseline, above age 75, not married or partnered, in fair or poor health, and having a disability. EF and similar exercise programs may be able to provide additional support for the groups identified here.

2.4.1 *Physical Function Improvement across All Follow-ups*

Greater EF attendance was associated with improved physical function. Results are consistent with previous EF research (Belza et al., 2006; Centers for Medicare & Medicaid Services, 2013), and the well-demonstrated association between physical activity attendance and physical function (Finch, Owen, & Price, 2001; Sjosten et al., 2007; Stineman et al., 2011). Although this sample was generally adherent to the EF program (the mean for first program cycle was 11.5 weeks out of 16 possible), there was still a significant association with attendance. This is particularly remarkable because our inclusion criteria constrained variation among participants in attendance. This suggests that even small improvements in attendance can benefit physical function.

EF participants improved in the age and sex normative categories across each program cycle (e.g., those in the above normal category for arm curls grew by 1,022, while those in the normal category shrunk by 581), suggesting results are clinically significant. These continued gains are important because many programs for older adults are unable to stop functional decline or lead to longer-term improvements among those in the worst health (Aaronson et al., 1993; Giné-Garriga et al., 2014). Nonetheless, physical activity decreases impairment and improves recovery from impairment (Haveman-Nies, De Groot, & Van Staveren, 2003; Wannamethee, Ebrahim, Papacosta, & Shaper, 2005). For example, one study found every hour of physical activity (e.g., each EF class) beyond the baseline mean was associated with an 11% decreased risk of death and a 7% decreased risk of developing a disability (Boyle et al., 2007). Another study found each extra hour of physical activity was associated with a 3% decrease in the rate of mobility decline (Buchman et al., 2007).

2.4.2 *Reductions in Function across Groups*

The demographics and health conditions we found to be associated with lower improvement in physical function was consistent with previous literature (Lee, 2000). Older adults, particularly those in the worst health, often are not able to achieve improved function (de Labra et al., 2015; Giné-Garriga et al., 2014), although evidence still supports the value of physical activity in improving physical function more broadly (Gill et al., 2004; Liu & Latham, 2009; Nelson et al., 2007; Warburton et al., 2006). These groups' lower improvement is not likely due to differences in attendance or baseline performance, because we controlled for these in our models. We also controlled for a list of comorbidities. However, these variables may not have fully accounted for their potential effects. Differences in EF effectiveness may be due to discomfort in the environment or the instructor (known as proxy efficacy), a lack of individual engagement during class sessions, and health or knowledge barriers not captured in the model.

2.4.2.1 Implications

We found identifiable subgroups who have the most to gain from the program. Therefore, targeted efforts to provide additional support for these subgroups could pay big dividends in improved physical function.

2.4.2.2 Reaching Out to Groups at Risk

Two of the participant level predictors of physical function examined in this model were behavioral (i.e., activity level and attendance), and therefore can be controlled by the participant. Programs could target messaging and attempt to support or incentivize those behaviors. We found that even small improvements in attendance lead to improvements in physical function; and previous qualitative data suggest a motivating factor is social connection. Therefore, focusing on relationship building may be useful to increase activity in and out of the program. Examples of strategies include establishing a buddy system or phone tree to increase accountability, and including member of older adults' social network to motivate attendance (Belza et al., 2004; Biedenweg et al., 2014; Chiang et al., 2008).

For those predictors that are not under participants' control (i.e., demographic variables and health conditions), there are two ways to triage efforts: the prevalence of the risk factor, and the strength of its impact. Targeting those who were not partnered (about 46% of the sample) and females (about 80% of the sample) could impact the highest volume of people. It is possible lower gains in these groups could be the result of higher variability, given their high representation in the sample (e.g., men with lower function may be less likely to participate in the first place). Nonetheless, strategies to support these groups could include: program leadership providing instructors with training in communication and motivational techniques to ensure corrections in exercise form are understood; boost individual engagement; and focus individualized outreach from the instructor or peers (Buman et al., 2011; Ginis, Nigg, & Smith, 2013; Ntoumanis, Thøgersen-Ntoumani, Quested, & Hancox, 2016)

Targeting groups with the strongest associations (i.e., being above age 75, disabled, and in worse health) could help those with the most to gain; and maximize the public health benefits of the program. Strategies could include accommodating health problems that prevent engagement not specifically captured in the model (e.g., pain), optimizing treatment of pain or stiffness, instruction in energy conservation techniques, and gradated entry into regular exercise (Belza et al., 2004).

2.4.2.3 Increasing Number of Program Completers

The high number of participants who did not complete a program cycle, and were therefore dropped from this analysis point to high attrition rates. Alternatively, it is possible that participants stayed in the program but avoided the physical function test days, as instructors have reported anecdotally. If these participants have different performance, our results may overstate the amount of improvement. Adjustments in program delivery using the strategies identified in previous research may help retain and encourage attendance, even on test days. Strategies include adjusting marketing (e.g., highlight personal gains, low cost, and unique program features), simplifying logistics (e.g., times and location), and increasing options (e.g., variety of formats and targeting similar cultural or linguistic backgrounds) (Belza et al., 2004; Biedenweg et al., 2014; Chiang et al., 2008). Another strategy may be promoting the overall improvements in the population, who often are expected to decline. These data could gain the confidence of referring clinicians. Trust built from seeing evidence has been shown to be a motivator in making the decision to refer (Fishleder, Petrescu-Prahova, Steinman, Kohn, & Harris, 2016).

The difference between those in the sample and those dropped for this analysis are likely to be minimal in the real world setting, because the only statistically significant differences between the groups were very weak (with the exception of Asian race). The same health factors that predict reduced performance have also been identified as both motivators and barriers to EF attendance. Instructors and peers could have a role in encouraging participants through the barriers of chronic health conditions, and could re-emphasize the program's safety and modifiability (Belza et al., 2004; Biedenweg et al., 2014; Chiang et al., 2008).

2.4.3 *Strengths, Limitations, and Directions for Future Research*

Our study had several strengths, including using routinely collected program data from a large number of people in real-world settings, and being able to look at the same individual over time with multiple measurements. We included only participants with completed intervention cycles to avoid categorization bias. However, this limited the results to a select sample of relatively high-attending participants, and we cannot draw conclusions about participants who did not provide a follow-up fitness check. Further, we could not control for reverse causation, and some variables lacked context. For example, the falls variable did not include a cause; so participants could have fallen for a multitude of reasons, such as vestibular disease, lack of vision, decreased strength or reflexes, or even from high-intensity athletic activities. One additional consideration is variable program fidelity. However, a previous study found that EF maintains core elements of the tested intervention, and has mechanisms to track and enhance fidelity (e.g., instructor certifications, participant program manuals, and periodic reviews with Master trainers) (Frank, Coviak, Healy, Belza, & Casado, 2008).

Future qualitative research could attempt to learn how to better support participants throughout their time in the program, and to identify site-specific barriers to efficacy, which are likely highly variable. Evaluation modifications could include directly collecting data to identify underlying barriers to program's efficacy. Additional analysis may use methods such as a structural equation models to see the complex web of associations more accurately. Another analysis may determine how many participants skip test days.

2.5 CONCLUSION

EF attendance was associated with clinically important improvements in physical function in older adults, with increased improvement over time and with higher attendance. The groups identified as at risk of fewer improvements are not surprising, given previous literature. Results highlight the need to continue to understand and address barriers to improvements in these groups. Implications for programs include targeting messaging, and coordinating with referring providers to emphasize attendance and general activity in specific participants, and offering additional support to at-risk groups during EF classes. Programs could also make efforts to help participants understand how test days can give valuable feedback about their functional changes.

Table 2.1 *Overview of Demographics of EnhanceFitness Participants Enrolled 2005-2016 from Baseline to 8 Months*

	All Participants (n=6,442)	
	n	**%**
Gender (n=6,379)		
Male	1,167	18.12
Female	5,212	80.91
Marital Status (n=5,150)		
Married or Partnered	2,341	36.34
Widowed, Divorced, Single or Separated	2,809	43.60
Age (n=6,322)		
65-75 Years	3,322	52.51
75-85 Years	2,310	36.52
85 years and above	694	10.97
Race (n=5,445)		
White	3,969	61.61
Black/African-American	704	10.93
Native American	76	1.18
Asian/Asian-American	511	7.93
Hawaiian Native/Pacific Islander	26	0.40
Multi	159	2.47
Hispanic Ethnicity (n=5,441)	325	5.05
Disability (n=5,151)	1,018	15.80
Self Reported Health at Baseline (n=6,053)		
Excellent/Very Good/Good	5,356	83.14
Fair/Poor	697	10.82
Number of Falls at Baseline (n=5,456)		
None	4,560	70.79
1 or More	896	13.91
Number of Physically Active Days at Baseline (n=4,964)		
0-3 Days	3,218	49.95
4 Days or More	1,746	27.10
Chronic Diseases Present (n=6,209)		
Hypertension or Heart Disease	2,161	33.55
Arthritis or Rheumatic Disease	2,373	36.84
Diabetes or Prediabetes	807	12.53
Asthma or Lung Disease	393	6.10
Depression	376	5.84
Cancer	644	10.00