Pilot Enhancement of the Arthritis Foundation Exercise Program with a Healthy Aging Program

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ABSTRACT

Older adults with arthritis or joint pain were targeted for a pilot program enhancing the Arthritis Foundation Exercise Program with the 10 Keys™ to Healthy Aging Program. Using a one-group, pre-post design, feasibility was examined and improvements in preventive behaviors, arthritis outcomes, and cardiometabolic outcomes were explored. A 10-week program was developed, instructors were recruited and trained, and four sites and 51 participants were recruited. Measures included attendance, adherence, satisfaction, preventive behaviors, Western Ontario and McMaster Universities Osteoarthritis Index (pain and stiffness), glucose, and cholesterol. Three fourths of participants attended >50% of the sessions. At 6 and 12 months, more than one half performed the exercises 1 to 2 days per week, whereas 28% and 14% exercised 3 to 7 days per week, respectively. Participants (92%) rated the program as excellent/very good. Nonsignificant changes were observed in expected directions. Effect sizes were small for arthritis and cardiometabolic outcomes. This program engaged community partners, demonstrated feasibility, and showed improvements in some preventive behaviors and health risk profiles.

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Older adults with osteoarthritis form a high-risk group that may benefit from an enhanced exercise program that addresses disability prevention (Rushton & Kadam, 2014). Osteoarthritis is a major public health problem in the United States, with 27 million individuals estimated to have clinical evidence of the disease in 2005 (Lawrence et al., 2008). Osteoarthritis limits physical activity and is one of the most common causes of disability in older adults (U.S. Burden of Disease Collaborators, 2013). The aging of the population and increasing prevalence of obesity have contributed to the higher number of individuals affected in recent decades (Suri, Morgenroth, & Hunter, 2012). In fact, obesity prevalence is 54% higher in individuals with arthritis than those without arthritis (Centers for Disease Control and Prevention, 2011). Osteoarthritis commonly coexists with other chronic diseases (Hosseini et al., 2012), which significantly adds to poor physical and mental health (Geryk, Carpenter, Blalock, DeVellis, & Jordan, 2015), pain (Cimmino et al., 2013), and health care costs (Chi, Lee, & Wu, 2011). Because individuals with osteoarthritis often have disability, and those with increasing disability have 1.26 (95% confidence interval [CI] [1.12, 1.42]) times greater odds to experience a cardiovascular (CV) event compared to those without disability (Hoeven et al., 2015), preventing disability in this population is important. Effective prevention programs focusing on arthritis-related disability as well as other chronic diseases could strategically help reduce the overall burden of disability in this population (Parekh, Goodman, Gordon, & Koh, 2011), with downstream implications for decreased health care costs and caregiver burden.

The occurrence of multiple simultaneous chronic conditions among older adults is common and associated with a higher risk for mortality (Emerging Risk Factors Collaboration, 2015), increased health care costs (Konig et al., 2013), psychological distress, and limitation in social participation (Qin et al., 2015). Community-dwelling older adults with such multiple comorbidities face challenges in prioritizing and managing them, which has implications for interventions to improve health behaviors and outcomes (Bower et al., 2012). It is therefore important to improve awareness and target multiple conditions when introducing prevention programs addressing disability among older adults.

Blood pressure control and lipid lowering are known to be highly effective in reducing CV disease, disability, and death (Kostis et al., 2011; Krousel-Wood et al., 2012; Lloyd et al., 2013). Reducing cardiometabolic risk factors often requires a multifaceted regimen of medication, physical activity, and healthy eating (Institute of Medicine, 2012). There is a paucity of such multi-pronged interventions designed to dually prevent CV disease and reduce the overall risk for disability in individuals with comorbidities in primary care and community settings (Rushton & Kadam, 2014). These types of interventions could be effectively implemented and sustained by community-based collaborations that allow for greater sharing of available resources and dissemination.

In 2010, collaboration between the Arthritis Foundation of Western Pennsylvania and University of Pittsburgh Center for Aging and Population Health–Prevention Research Center (CAPH-PRC) resulted in the development and implementation of a model prevention program, which enhanced an exercise program for arthritis (Callahan et al., 2008; Suomi & Collier, 2003) with a preventive health behavior program (Newman et al., 2010; Robare et al., 2011) focusing on prevention of diseases most likely to affect older adults. With some overlapping goals focused on promoting health behaviors and preventing disability, it was ideal to blend the two programs. As reported below, each program had been previously demonstrated to be effective.

Callahan et al. (2008) conducted a randomized clinical trial that evaluated the self-efficacy–based, 8-week Arthritis Foundation Exercise Program (AFEP) and found that at 8 weeks the intervention group compared to the control group demonstrated significant improvements in pain, fatigue, and self-efficacy for managing arthritis. At 6 months, intervention participants sustained significant improvements in symptoms, but showed decreases in function and self-efficacy. Another randomized clinical trial with 30 older adults compared the AFEP to a wait list control group and found that the program significantly decreased pain during activities of daily living and increased performance-based functional measures, specifically flexibility, dynamic balance, hand-eye coordination, arm curls, and shoulder and hip isometric strength at the end of 8 weeks (Suomi & Collier, 2003).

The 10 Keys™ to Healthy Aging program of the CAPH-PRC is a preventive health behavior program targeting the most frequent chronic disease risk factors among older adults. The 10 Keys are (a) control blood pressure, (b) regulate blood glucose, (c) lower low density lipoprotein-cholesterol (LDL-C), (d) stop smoking, (e) participate in cancer screenings, (f) receive regular immunizations, (g) be physically active, (h) prevent bone loss and muscle weakness, (i) maintain social contact, and (j) combat depression (Center for Aging and Population

Health, 2014). The program, guided by social cognitive theory (Bandura, 1986), incorporates evidence-based behavioral strategies to prevent disease and disability among older adults. The 10 Keys was launched and tested in a high-risk population and found to be effective in improving diverse indicators of preventive health (Newman et al., 2010). At 12-month follow up, improvements in the proportion of participants meeting goals for LDL-C, blood pressure control in those with hypertension, blood glucose control in those with diabetes, and colon cancer screening were observed. This program also resulted in significant reductions in key risk factors, increases in immunizations, and adherence to established prevention guidelines over 2 years (Robare et al., 2011).

The purpose of the current study was to pilot test the collaborative model enhancing the AFEP with the 10 Keys to Healthy Aging program in preparation to launch a clustered randomized trial. The first aim was to examine the feasibility of the enhanced exercise program through assessment of participant attendance, adherence, and satisfaction. The second aim was to explore whether the enhanced exercise program improved self-reported preventive health behaviors, arthritis outcomes (i.e., joint pain and stiffness), and cardiometabolic outcomes (i.e., blood glucose and LDL-C), which were the primary outcomes in the larger trial.

METHOD

Design

The current quasi-experimental, pre-post pilot study conducted assessments at baseline, post-program (10 weeks), 6 months, and 12 months. The 12-month time point was of primary interest. The University of Pittsburgh Institutional Review Board approved the study.

Setting

The current pilot study was conducted in four diverse community-based sites in the metropolitan area of a mid-sized city in the mid-Atlantic region of the United States. All sites conducted the same program, which enhanced the AFEP with the 10 Keys to Healthy Aging. The sites comprised a church in an underserved community, a classroom in the local hospital in the same underserved community, a fitness facility in a middle-class suburb, and a retirement residence in an upper class community. The choice of site was based on the availability of group exercise leaders and the sponsors' willingness to participate. The underserved community, in comparison to county statistics, had a larger percentage of African American older adults (27% versus 13%), smaller percentage with a college degree (10% versus 35%), lower median income ($27,315 versus $49,340), larger percentage without health insurance (15% versus 8%), and a larger percentage with disability (21% versus 13%), especially among those 65 and older (41% versus 35%), respectively. The underserved community and county were comparable in terms of percentages female (53% versus 52%) and 65 and older (17.5% versus 16.7%), respectively.

Sample

A variety of methods were used to recruit participants, including a mass mailing to targeted zip codes, flyers, advertisements in local newspapers, announcements in membership mailings, and integration into an existing exercise program. Participation in the program was open to anyone in the community. If participants were interested in enrolling in the research study, they called the research office and gave verbal consent for a phone screening. Participants were eligible for the research study if they were 50 or older and did not have medical contraindications, including unstable angina, oxygen use, or chest, abdominal, or orthopedic surgery requiring inpatient stay in the previous 6 months. Noninterested individuals could participate in the program, but need not enroll in the study. A similar process was followed if participants came to the first session and eligibility was in question. All participants signed the standard release form for the Arthritis Foundation, and all research participants provided written informed consent.

Intervention

The program enhanced the AFEP with the 10 Keys to Healthy Aging. The research team, the Arthritis Foundation trainer and program manager, and an experienced AFEP instructor met to design the enhanced exercise program. Prior to program delivery, instructors attended a 1-day AFEP training that included a pre-training module on arthritis and related conditions, completed an online education program for the 10 Keys to Healthy Aging, and were oriented to the structure of the sessions to achieve enhancement. At the AFEP training, all instructors signed a statement indicating agreement to teach at least one 10-week program in cooperation with the research study within the year following their training. All instructors were CPR certified.

The enhanced exercise program was 10 weeks in duration; three sites held sessions twice per week; one site held one session per week due to space and time constraints (the instructor for this site collected information about participants' other physical activity). Each session was 75 minutes in length. The AFEP was delivered in the standard 60-minute format: instructors could select their specific exercises but each domain was included in each session (i.e., joint check warm-up, active range of motion, strengthening, health education, joint check cool down, and relaxation). Although the AFEP usually lasts 8 weeks, it was expanded to 10 weeks to accommodate presentation of each of the 10 Keys. The 10 Keys portion of each session was 15 minutes in duration; the first session of the week was an introduction to the Key, and the second session of the week was reinforcement of the Key. Participants were encouraged to identify and prioritize prevention goals that needed action. Possible strategies to reach these goals were discussed, such as lifestyle changes and medical treatments. Action plans included a variety of evidence-based behavioral strategies: building knowledge, self-monitoring, cueing, changing behavior in small steps, self-reinforcing behavior changes, developing new skills, mobilizing social support, and accessing community resources and health care providers. A Prevention in Practice (PIP) report was completed and revisited over the course of the program. Participants were urged to share their PIP report with their health care providers to gain support in meeting their goals. In one site, the addition of four monthly maintenance sessions were developed and pilot tested to enhance adherence to participants' health goals.

Intervention fidelity to the enhanced exercise program was addressed by regular site visits by the AFEP and 10 Keys trainers, coaching of program instructors to maintain integrity of all intervention components, and weekly follow-up telephone calls to discuss and manage any issues that arose at the sessions. The enhanced exercise program was delivered as intended at 100% in all four sites.

Measures

Feasibility. Program attendance was recorded by program instructors. Adherence to the AFEP exercises was measured by self-reported frequency of performance (number of days per week). Satisfaction was assessed on an investigator-developed 5-point Likert scale from *poor* to *excellent* for the following items: program instructor, exercises, health messages, and overall rating of the enhanced program. A single item on a 4-point Likert scale was used to assess the degree to which the enhanced program met expectations with the following choices: *I was disappointed*, *I was expecting a little more*, *met expectations*, and *exceeded expectations*.

Preventive Health Behaviors. A self-administered questionnaire was used to collect information about current health conditions and preventive health behaviors at baseline, 6 months, and 12 months, including smoking status, cancer screenings (i.e., mammography for women and colonoscopy for men and women), immunizations (i.e., influenza and pneumonia), physical activity (150 minutes per week), musculoskeletal health (i.e., bone density test for women, body mass index [BMI] <30, not falling in the past year, no difficulty walking one quarter mile, and no difficulty rising from a chair), social contact (i.e., get together with friends or family *almost every day* or *once per week*), and combating depression (cheerful *all of the time* or *most of the time*).

Arthritis Outcomes. Because the knee or hip joints are commonly affected in arthritis and lower extremity arthritis contributes greatly to disability, the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index was used to assess lower extremity joint pain and stiffness. The WOMAC uses a 5-point Likert subscale (0 to 4), with higher scores indicating greater pain and stiffness (Bellamy, 2009; Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988). The 5-item Pain subscale (0 to 20 possible points) collected information about joint pain for the past 48 hours. It has high internal consistency (Cronbach's alpha = 0.86 to 0.89), adequate 1-week test–retest reliability (Kendall's tau = 0.68), and evidence of construct validity. The 2-item Stiffness subscale (0 to 8 possible points) was used to measure joint stiffness during the past 48 hours. It has high internal consistency (Cronbach's alpha = 0.90 to 0.91), adequate 1-week test–retest reliability (Kendall's tau = 0.48), and evidence of construct validity. In the current study, internal consistency reliabilities were 0.89 and 0.90, respectively.

Cardiometabolic Outcomes. A finger stick was performed on site and the blood was analyzed for fasting blood glucose and LDL-C using an Alere™ Cholestech machine. The research staff confirmed fasting status and length of fast. Results were given to participants during the assessment.

Data Analysis

The categorical variables were summarized using percentages, and the continuous variables were summarized using means and standard deviations, or medians and ranges. The first aim was addressed using frequencies to describe participant attendance, adherence, and satisfaction. The second exploratory aim that self-reported preventive health behaviors, arthritis outcomes, and cardiometabolic outcomes would improve was addressed using an intent-to-treat repeated measures mixed modeling procedure

(PROC MIXED or PROC GLIMMIX). A three-level mixed effects model included a random intercept to adjust for variability between sites at the four time points (Level 3), individual participants (Level 2), and repeated measures of outcomes (Level 1). The models included effects for post-program, 6 months, and 12 months using the baseline value as reference. The effect over time was tested and presented as P_{trend}. All analyses were performed using SAS version 9.3. Because the pilot study was not powered to determine effectiveness, significant results were not expected. Cohen's *d* was computed for the arthritis and cardiometabolic outcomes for use in the power analysis of the larger trial.

TABLE 1

Enrollment and Attrition Rates Across Study Sites

Study Site	Class Participants, *n*	Participants Enrolled, *n* (%)	Attrition, *n* (%)
Church in underserved community	23	11 (47.8)	1 (4.3)
Hospital in underserved community	20	15 (75)	2 (10)
Fitness facility in middle-class suburb	24	13 (54.2)	2 (8.3)
Retirement residence in upper class community	16	12 (75)	4 (25)
Total	83	51 (61.4)	9 (10.8)

RESULTS

Participants

There were 122 prospective participants, 83 of whom attended at least one class as shown in **Table 1**. Of these 83, 51 were consented research participants with percentage enrollment into the study ranging from 47.8% to 75% across the four sites. Of the 51 participants enrolled, 45 completed baseline assessments, 40 completed post-program assessments, 36 completed 6-month assessments, and 35 completed 12-month assessments. Reasons for missing assessment data included hospitalization, lack of transportation, work conflict, and did not attend assessment visit or return questionnaires. Attrition for the four sites was 4.3% at the church in the underserved community, 10% at the hospital in the underserved community, 8.3% at the fitness facility in the middle-class suburb, and 25% at the retirement residence in the upper class community. Research participation was not required; indeed, linking research with service delivery was of interest in determining feasibility of the enhanced program.

Average age of the research participants was 75.5 (*SD* = 9.3 years), 88% (*n* = 45) were female, and 92% (*n* = 47) were White, with 72% (*n* = 36) having at least some college education and 73% (*n* = 37) reporting an arthritis diagnosis. In addition, of 43 participants, 56% (*n* = 24) reported having hypertension, 42% (*n* = 18) osteoporosis, 21% (*n* = 9) diabetes, and 12% (*n* = 5) depression. Some participants used assistive devices, including a cane (14%, *n* = 6), walker (7%, *n* = 3), and wheelchair (5%, *n* = 2). Using anonymously collected demographic data from the non-research participants, significantly more non-research participants reported having arthritis compared to the research participants (96%; *n* = 24, *p* = 0.02).

Feasibility

Attendance was good with 75% (*n* = 38) of participants attending more than 50% of the classes. Attendance at 80% or more of the classes was higher in the two sites in the underserved community (27% at the church and 25% at the hospital) compared to the other two sites (15% at the fitness facility in the middle-class suburb and 19% at the retirement residence in the upper class community). At 6 and 12 months, adherence to the AFEP exercises was satisfactory with 53% (*n* = 19) and 54% (*n* = 19) reportedly exercising 1 to 2 days per week and 28% (*n* = 10) and 14% (*n* = 5) reportedly exercising 3 to 7 days per week, respectively. Program instructors were rated as *excellent* by 62.2% (*n* = 23) and *very good* by 27% (*n* = 10) of participants. The participants rated both components of the enhanced exercise program very highly. A total of 97% rated the exercises as *excellent* (48.7%, *n* = 18) or *very good* (48.7%, *n* = 18). Approximately 95% rated the 10 Keys health messages as *excellent* (59.5%, *n* = 22) or *very good* (35.1%, *n* = 13). Approximately 92% gave the enhanced exercise program an overall rating of *excellent* (56.8%, *n* = 21) or *very good* (35.1%, *n* = 13). A total of 97% said that the enhanced exercised program *met* (46%, *n* = 17) or *exceeded* (51.4%, *n* = 19) their expectations.

Preventive Health Behaviors

Table 2 provides the results of the adjusted mixed models for the self-reported preventive health behaviors. Because unadjusted results are similar, they are not

TABLE 2

Preventive Health Behaviors and Arthritis Outcomes

Primary Outcome	Baseline ($N = 43$) n (%)	Post-Program ($N = 40$)[a] n (%)	6 Months ($N = 36$)[a] n (%)	12 Months ($N = 35$)[a] n (%)	P_{trend}[b]
Control SBP to <140 mmHg[c]	28 (66.7)	NA	17 (48.6)	19 (59.4)	0.86
Hypertension at baseline ($n = 24$)	16 (66.7)	NA	9 (47.4)	10 (58.8)	0.98
Stop smoking or never smoked[c]	35 (83.3)	NA	32 (88.9)	31 (88.6)	0.32
Participate in cancer screenings					
Mammogram (women only)[c]	25 (67.6)	NA	23 (71.9)	22 (75.9)	0.57
Colonoscopy[c]	35 (85.4)	NA	30 (83.3)	29 (82.9)	0.27
Get regular immunizations					
Influenza (annual)[c]	26 (61.9)	NA	25 (69.4)	21 (61.8)	0.46
Pneumonia (lifetime)[c]	27 (65.9)	NA	25 (69.4)	25 (71.4)	0.23
Regulate blood glucose <100 mg/dL[c]	12 (30.8)	NA	2 (5.9)	5 (15.2)	0.16
Lower LDL-C to <100 mg/dL[c]	3 (7.7)	NA	2 (5.9)	0 (0)	0.11
Baseline LDL-C >130 mg/dL ($n = 10$)	0 (0)	NA	1 (11.1)	0 (0)	NA
Be physically active ≥2.5 hours per week[c]	26 (70.3)	27 (69.2)	22 (64.7)	15 (45.5)	0.02

reported. There were no significant changes over time in the percentage who self-reported meeting the systolic blood pressure goal of <140 mmHg in the sample (–7.3%) and in those with hypertension (–7.9%). The percentage of participants who stopped smoking or never smoked showed a nonsignificant improvement over time (+5.3%). No significant changes were noted over time in the percentages reporting mammography screening (+8.3%), colonoscopy (–2.5%), influenza immunization (–0.1%), and pneumonia immunization (+5.5%). Subgroup analysis of individuals who did not have the influenza vaccine at baseline indicated that 31.3% had received it at 6 months.

There were no significant changes over time in those who self-reported meeting the blood glucose goal of <100 mg/dL (–15.6%) and the LDL-C goal of <100 mg/dL (–7.7%). The percentage of participants reporting that they are physically active for at least 2.5 hours per week significantly decreased over time (–24.8%, $p = 0.02$). Five measures of musculoskeletal health were analyzed and demonstrated no significant changes over time: get a bone mineral density test in women (–6.5%), maintain BMI (+0.5%), not falling (+1.6%), no difficulty walking (+7.3%), and no difficulty rising from a chair (+6.2%). However, the measure of not falling showed significant improvement from baseline to post-program ($p = 0.03$). No significant changes were found over time in the percentages of participants reporting social contact (+3%) and combating depression (+0.4%).

Arthritis Outcomes

The results of the adjusted mixed models for the arthritis outcomes are shown in **Table 2**. Because unadjusted results are similar, they are not reported. The two subscales of the WOMAC Osteoarthritis Index showed nonsignificant improvements over time for pain (–1.0) and stiffness (–0.8). Effect sizes were small for pain (Cohen's $d = 0.23$) and stiffness (Cohen's $d = 0.39$).

Cardiometabolic Outcomes

Table 3 provides the results of the adjusted mixed models for the cardiometabolic outcomes. Because unadjusted results are similar, they are not reported. Blood glucose did not significantly change over time in the sample (+6.2 mg/dL) or the subgroup that reported diabetes at baseline (+13.8 mg/dL). Blood glucose initially decreased post-program but increased by 12 months. A similar pattern was observed for the percentage of participants meeting the goal of <100 mg/dL for blood glucose (Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003), which was −10.8%. Effect size was small and in the opposite direction as anticipated for blood glucose (Cohen's $d = 0.28$).

There were nonsignificant improvements over time in LDL-C in the sample (−11.9 mg/dL) and in those with LDL-C >130 mg/dL at baseline (−35.6 mg/dL). Compared to baseline values, participants with baseline LDL-C >130 mg/dL demonstrated significant improvements in LDL-C at both post-program ($p = 0.03$) and 12-month follow up ($p = 0.005$). When using the goal of LDL-C <100 mg/dL (National Cholesterol Education Program Expert Panel, 2002), there were nonsignificant improvements over time in the percentage of participants meeting the goal by clinical assessment in the sample (+16%). Effect size was small for LDL-C (Cohen's $d = 0.38$).

DISCUSSION

The current pilot study found that community partners could be engaged to develop, implement, and evaluate an enhanced exercise program for arthritis that was novel in using objective and subjective outcomes in the program assessment. Nolte, Elsworth, Newman, and Osborne (2013) noted that chronic disease self-management programs often rely on self-report measures that are prone to measurement error and bias. Participant attendance was good, especially at sites

TABLE 2 (CONTINUED)

Preventive Health Behaviors and Arthritis Outcomes

Primary Outcome	Baseline ($N = 43$) *n* (%)	Post-Program ($N = 40$)[a] *n* (%)	6 Months ($N = 36$)[a] *n* (%)	12 Months ($N = 35$)[a] *n* (%)	P_{trend}[b]
Musculoskeletal health					
Bone mineral density test (women only)[c]	32 (86.5)	NA	28 (90.3)	24 (80)	0.82
Maintain BMI <30[c]	25 (59.5)	NA	16 (50)	21 (60)	0.79
Not falling in the past year	30 (69.8)	38 (95)*	29 (80.6)	25 (71.4)	0.54
No difficulty walking one quarter mile	30 (69.8)	29 (72.5)	29 (80.6)	27 (77.1)	0.47
No difficulty getting up from a chair[c]	33 (76.7)	34 (85)	31 (91.2)	29 (82.9)	0.83
Maintain social contact at least once per week[c]	38 (88.4)	37 (92.5)	32 (91.4)	32 (91.4)	0.84
Combat depression: being cheerful most or all of the time[c]	33 (76.7)	33 (86.8)	27 (77.1)	27 (77.1)	0.67
	Mean (*SD*), Median (Range)				
WOMAC Pain (0 to 20)	6.2 (4.7), 6 (0 to 19)	6.3 (4.4), 6 (0 to 20)	5.8 (4), 5.5 (0 to 15)	5.2 (4.1), 5 (0 to 15)	0.38
WOMAC Stiffness (0 to 8)	3.3 (2.2), 4 (0 to 8)	3 (2.1), 3 (0 to 8)	2.9 (1.8), 3 (0 to 7)	2.5 (1.9), 2 (0 to 5)	0.13

Note. SBP = systolic blood pressure; NA = not available; LDL-C = low-density lipoprotein cholesterol; BMI = body mass index; WOMAC = Western Ontario and McMaster Universities.

[a] 38 participants had both baseline and post-program assessment; 35 participants had both baseline and 6-month assessment; 34 participants had both baseline and 12-month assessment.

[b] The mixed models were used to account for repeated measurements in the four different sites at the four time points.

[c] Missing information: SBP at baseline ($n = 1$), 6 months ($n = 1$), and 12 months ($n = 3$); smoking at baseline ($n = 1$) and 6 months ($n = 2$); mammogram at 12 months ($n = 1$); colonoscopy at baseline ($n = 2$) and 12 months ($n = 1$); influenza shot at baseline ($n = 1$) and 12 months ($n = 1$); pneumonia shot at baseline ($n = 2$); blood glucose at baseline ($n = 4$), 6 months ($n = 2$), and 12 months ($n = 2$); LDL-C at baseline ($n = 4$), 6 months ($n = 2$), and 12 months ($n = 2$); be physically active ≥2.5 hours per week at baseline ($n = 6$), post-program ($n = 1$); bone mineral density test at 6 months ($n = 1$); BMI at baseline ($n = 1$) and 6 months ($n = 4$); no difficulty getting up from a chair at 6 months ($n = 2$); maintain social contact at least once per week at 6 months ($n = 1$); combat depression at 6 months ($n = 1$).

*$p < 0.05$ for adjusted p values compared with baseline data.

TABLE 3

Cardiometabolic Outcomes

Cardiometabolic Outcome	Baseline ($N = 45$)	Post-Program ($N = 35$)[a]	6 Months ($N = 34$)[a]	12 Months ($N = 23$)[a]	P_{trend}[b]
Blood glucose (mg/dL)[c]	100.7 (19.5)	99.9 (18.3)	107.1 (20.7)	106.9 (26.3)	0.34
Diabetes at baseline ($n = 9$)	127.4 (20.8)	120.6 (26.4)	127.6 (21)	141.2 (31.9)	0.55
Blood glucose <100 mg/dL[c] (n, %)	24 (63.2)	20 (64.5)	10 (35.7)	11 (52.4)	0.52
LDL-C (mg/dL)[c]	110.2 (33.3)	109.3 (25.9)	111 (37.7)	98.3 (28.3)	0.43
Baseline LDL-C >130 mg/dL ($n = 10$)	151.2 (18)	122 (28.4)*	150 (38)	115.6 (27.2)**	0.08
LDL-C <100 mg/dL[c] (n, %)	12 (36.4)	10 (38.5)	12 (44.4)	11 (52.4)	0.07

Note. LDL-C = low-density lipoprotein cholesterol.
[a] 35 participants had both baseline and post-program assessment; 34 participants had both baseline and 6-month assessment; 23 participants had both baseline and 12-month assessment.
[b] The mixed models were used to account for repeated measurements in the four different sites at the four time points.
[c] Missing information: glucose at baseline ($n = 7$), post-program ($n = 4$), 6 months ($n = 6$), and 12 months ($n = 2$); LDL-C at baseline ($n = 12$), post-program ($n = 9$), 6 months ($n = 7$), and 12 months ($n = 2$).
*$p < 0.05$; **$p < 0.01$ for adjusted p values compared with baseline data.

in the underserved community, exercise adherence was satisfactory, and participants rated the enhanced program as *excellent* or *very good* (92%) and indicated that it *met* or *exceeded their expectations* (97%). Attendance and adherence were comparable to other exercise programs for individuals with arthritis (Bennell, Kyriakides, Hodges, & Hinman, 2014; Pisters et al., 2010).

Not unexpectedly, the enhanced exercise program did not find statistically significant changes over time in self-reported preventive health behaviors, arthritis outcomes, and cardiometabolic outcomes due to being an underpowered pilot study with a small sample size. However, six of 10 preventive health behaviors showed slight improvement (i.e., stop smoking, participate in cancer screenings, receive regular immunizations, prevent bone loss and muscle weakness, maintain social contact, and combat depression). These findings are generally consistent with those reported in other studies of the 10 Keys program (Newman et al., 2010; Robare et al., 2011).

The enhanced program had small effects on improvement in both pain and stiffness. The minimal clinically important differences (MCIDs) for WOMAC subscale scores in patients with hip and knee osteoarthritis participating in inpatient rehabilitation ranged from 0.67 to 0.75 for improvement (Angst, Aeschlimann, & Stucki, 2001). Participants in the enhanced program showed slightly greater MCIDs of 1.0 for pain and 0.8 for stiffness. These results are similar to those reported in other studies of the AFEP (Callahan et al., 2008; Suomi & Collier, 2003).

Although the enhanced program did not favor an improvement in blood glucose, there was a small effect on improvement in LDL-C. In addition, participants with baseline LDL-C >130 mg/dL showed significant improvements in LDL-C at both post-program and 12-month follow up. These findings differ somewhat from those reported in other studies of the 10 Keys program that found improvements in blood glucose and LDL-C (Newman et al., 2010; Robare et al., 2011), perhaps due to one half of the current pilot study sample living in an underserved area with less access to health care.

Unexpectedly, the percentage of participants who were physically active for at least 2.5 hours per week showed a statistically significant decrease of –24.8%. One possible explanation is that participants overestimated their physical activity at baseline and corrected their estimates after participating in the enhanced program. The goal of 150 minutes per week of physical activity may be somewhat high for a sample of older adults with comorbidities, some of whom used assistive devices for mobility. Despite approximately less than one half achieving this physical activity goal at 12 months, 68% reportedly continued the AFEP exercises at 12 months, which exceeds the typical 50% adherence rate at follow up (Dunbar-Jacob, Schlenk, & McCall, 2012).

LIMITATIONS

The current pilot study had a few limitations. First, the sample size was small, especially for some of the subgroup analyses; however, the study provided effect sizes to power a larger study. A post-hoc power analysis showed that power was ≤0.60 across the multiple outcomes in the current pilot study. Second, the sample was largely homogeneous (White and female) and generally healthy but with prevalent musculoskeletal and CV comorbidities being reported, which limits generalizability. Although only four sites were included in the current study, the sites were diverse in terms of socioeconomic status and racial composition of the surrounding neighborhoods from which participants were drawn, which enhances the likelihood of dissemination across a variety of communities. Third, because the study design did not include a control group, the observed changes could be due to other factors, such as testing or historical events. Fourth, the convenience sample may produce a sampling bias as those who enrolled in the study were willing to engage in study activities over and above program participation itself.

FUTURE RESEARCH AND IMPLICATIONS

These findings suggest some directions for future research. First, some measures showed loss of improvements at 6- and 12-month follow up, which indicates that a maintenance program may be needed. Indeed, a powered, clustered randomized trial comparing the enhanced exercise program to the AFEP includes a maintenance component. Second, the current pilot study stimulated the research team to consider ways to embed more of the outcomes as part of program evaluation for all attendees, not just research participants. Third, although the two programs were blended due to overlapping goals, with an increase in the standard AFEP session duration by only 15 minutes, future studies can consider similarity in goals and session length when enhancing a program.

There are several implications for clinical practice with the population of older adults with mobility disability due to arthritis who are in need of preventive self-management strategies. Availability of community-based programs, such as the current enhanced exercise program, gives health care providers another tool to recommend to their patients. Participants can share their progress, such as the PIP report, with their providers to receive positive reinforcement for healthy lifestyle actions taken that, in turn, can produce positive clinical outcomes desired by the providers for their patients. Third party payors may be equally interested in enhanced programs that encourage disease prevention and help prevent disability among older adults they insure.

CONCLUSION

The current pilot study provided direction in launching a clustered randomized trial of a collaborative model enhancing the AFEP with the 10 Keys to Healthy Aging program. The authors demonstrated that community partners could be engaged in terms of development of an enriched curriculum, recruitment of sites and participants, training of instructors, and evaluation of cardiometabolic outcomes. The enhanced program was highly rated by participants and showed improvements in expected directions in some preventive health behaviors and health risk profiles. The challenge is to ensure that similar enhanced programs are sustained in the settings in which they are adopted. Strategies need to be devised early on to promote sustainability and fidelity, such as carefully selecting sites and instructors to ensure commitment, monitoring fidelity and retraining if indicated, embedding outcomes as part of program evaluation, and prioritizing limited resources to fund multifaceted prevention programs that link to the health care system. Collaborative programs that promote access to health care providers for preventive services can potentially yield positive outcomes for the growing numbers of older adults, consistent with federal health care law reforms to improve health care outcomes.

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