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A randomized controlled clinical trial of SPA -- the Seattle Protocol for Activity in older adults

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Abstract

OBJECTIVES—Evaluate the efficacy of a physical activity program (Seattle Protocol for Activity: SPA) for low-exercising older adults, compared to educational health promotion program (HP), combination treatment (SPA+HP), and routine medical care control conditions (RMC).

DESIGN—Single-blinded, randomized controlled trial with 2 × 2 factorial design. SETTING: November 2001 to September 2004, in community centers in King County, Washington.

PARTICIPANTS—273 community-residing, cognitively intact older adults (mean age, 79.2 y; 62% women).

INTERVENTIONS—SPA (in-class exercises with assistance setting weekly home exercise goals), and HP (information about age-appropriate topics relevant to enhancing health), with randomization to four conditions: SPA only (n = 69), HP only (n = 73), SPA+HP (n = 67), and RMC control (n = 64). Active treatment participants attended nine group classes over three months, followed by five booster sessions over one year.

MAIN OUTCOME MEASURES—Self-rated health (SF-36) and depression (GDS). Secondary ratings of physical performance, treatment adherence, and self-rated health and affective function were also collected.

RESULTS—At 3-months, participants in SPA exercised more and had significantly better self-reported health, strength, and general well-being ($p<.05$) than participants in HP or RMC. Over 18 months, SPA participants maintained health and physical function benefits, and had continued to exercise more than non-SPA participants. SPA+HP was not significantly better than SPA alone. Better adherence was associated with better outcomes.

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Author Contributions: Dr. Teri, as principal investigator, had full access to all study data and takes responsibility for all aspects of the study, including the integrity of the data and the accuracy of the data analysis. Drs. McCurry, Logsdon, and Larson assisted with acquisition of the data. Drs. Teri, Logsdon and McCurry supervised the study, Drs. Gibbons and Buchner provided statistical expertise, Drs. Teri, McCurry, Logsdon, and Gibbons assisted with the writing of the manuscript, and all authors contributed to study concept, design, interpretation of data, and critical review of the manuscript.

CONCLUSION—Older adults participating in low levels of regular exercise can establish and maintain a home-based exercise program that yields immediate and long-term physical and affective benefits.

Keywords

exercise; health promotion; aging; older adults

INTRODUCTION

Exercise may well be the single most important thing we can do to keep ourselves healthy as we age. Clinical and population-based studies have consistently demonstrated that regular physical activity increases strength and stamina, reduces risk for developing many common disabling age-related illnesses, maintains functional independence despite chronic illness, and reduces all-cause mortality in older adults.[1–3]

Recent randomized trials of home-based exercise programs for older adults have shown that such programs can significantly increase activity and positively impact physical health.[4–7] Studies suggest that older exercisers are less anxious,[8] sleep better,[9, 10] and report better quality of life.[9, 11] Regular exercise has also been reported to have mood-enhancing effects often comparable or superior to antidepressant medications, with benefits sustained over time.[12–14] Finally, evidence suggests physical activity may reduce the risk of cognitive decline[15, 16] and delay the onset of dementia in older adults.[17–20]

Between the years 2006–2008 in the US, however, only 26% of older adults age 65–74 engaged in regular leisure-time physical activity; for those age 75–84, only 20% did so, and among those 85 and over, the number dropped to 10.5%.[21] Recent exercise intervention studies, although often successful when targeting individuals with particular disorders,[22–25] have consistently reported a lack of long-term adherence, especially for older adults.[26–29] Although motivating individuals with age-related disabilities to begin and sustain an exercise program is challenging, there are well-accepted guidelines for the development of such programs.[30, 31] Key practices for promoting physical activity in older adult populations indicate that effective exercise programs should include social support, strategies to increase self-efficacy, activity choices, health contracts, assurances of safety, and positive reinforcement.[30–33]

This study investigated an easy-to-follow exercise program specifically designed to build upon these guidelines and utilize behavior change principles that have been shown effective with older adults with a range of physical limitations.[34, 35] We were particularly interested in developing, implementing, and evaluating a program with potential to be exported into the community. It needed to be inexpensive, requiring no cumbersome, specialized or costly equipment, safe for persons with a variety of comorbid health conditions, and easy to implement and follow. It also needed to be home-based, to enable older adults residing in a variety of domiciles – homes, apartments, and independent retirement centers – to participate. Finally, it needed to be systematic and standardized, yet allow enough flexibility to capture the interest and ability of individuals with varying degrees of physical limitations.

The primary aim of the current study was to develop a physical activity program that would meet these needs, and to test its efficacy compared to health promotion education and routine medical care. SPA (Seattle Protocol for Activity) is a nine-session, home-based program in which participants learn a range of balance and flexibility, strengthening, and aerobic physical activity skills. SPA was investigated alone and in combination with a Health Promotion program (HP) that was designed to further reinforce healthy behaviors

and provide mood-enhancing benefits above and beyond those directly related to exercise alone. It was hypothesized that: 1) SPA participants would improve significantly on measures of self-reported health and mood, whereas HP participants would show improvements in mood, compared with participants receiving routine medical care; and 2) participants in the combination SPA+HP program would show greater benefits than those in SPA or HP alone.

METHODS

Participants

Participants were 273 older adults recruited from a Group Health Cooperative/University of Washington cohort of persons without cognitive impairment,[36] community mailings, and local independent-living retirement centers. The study was approved by Institutional Review Boards of both the University of Washington and Group Health. Eligibility requirements included: living independently in the community, ambulatory, English-speaking, and not participating in regular exercise (≤ 150 minutes in the past week and not already attending a structured exercise program). Subjects were screened to rule out dementia using the Blessed Telephone Information-Memory-Concentration test.[37] Participants with stable chronic illnesses were not excluded from the study. Primary physicians for all participants were asked if there was any health reason the participant should not be enrolled in an exercise program, but no persons were excluded based on physician feedback. See Table 1 for baseline participant characteristics.

Procedures

Participants were randomized (in blocks of 8–10 consecutive subjects) into four treatment conditions: Seattle Protocol for Activity (SPA), Health Promotion (HP), SPA plus Health Promotion (SPA+HP), or Routine Medical Care (RMC), This ensured an even flow through the four conditions and balanced time trends, such as seasonal patterns. Assessments were conducted at baseline, 3 months (post-treatment), and 6, 12, and 18-months (follow up) by interviewers blind to treatment assignment. Assessments and treatment sessions were conducted in community senior centers and retirement residences.

Treatment Conditions

Participants in SPA and HP conditions met in small groups for 9 weekly 60 minute sessions followed by 2 bi-weekly 60 minute sessions over 3 months, followed by three monthly and two quarterly booster sessions, for a total of 14 sessions over one year. Master's-level trainers experienced in conducting exercise groups with older adults led all groups. Standardized treatment manuals included detailed instructions to group trainers, participant assignments and handouts, and forms for monitoring subject adherence. Trainers tracked exercises and content discussed in each session, and met weekly with supervisors to monitor treatment adherence. An outline of treatment sessions is provided in Table 2 and treatment manuals are available from the senior author.

SPA classes—The SPA curriculum had three main goals: 1) to provide a safe and effective home-based physical activity program, 2) to enhance short- and long-term adherence to activity goals using group social support, activity contracts, and positive reinforcement, and 3) to maximize short- and long-term treatment benefits. SPA classes included instruction in warm up and cool down exercises, and progressive resistance training using elastic tubing to increase participant strength, with exercises for each major muscle group (see Table 2). Balance and flexibility training was also provided to reduce risk for falls.[38, 39] Participants completed 8 – 12 repetitions of each exercise in class and had instructions to repeat strength training exercises on two additional nonconsecutive days

between class, and to complete 3 to 5 days a week of aerobic training (primarily walking at a moderate level of intensity increasing in duration as participants were able, to at least 30 minutes per day) on their own, outside of class. Balance and coordination exercises were encouraged for use as cool-down after walking.

SPA classes emphasized exercise safety, finding ways to make exercise enjoyable, and the long-term benefits of a sustained physical activity program. All exercises were linked to practical activities of daily living that are important for maintaining independence (e.g., ability to get up from a chair without assistance or carrying groceries). Each session included strategies for overcoming obstacles to increasing activity, such as scheduling challenges or physical limitations. Participants used checklists and pedometers to monitor their daily exercise outside of class, and these were reviewed at each session. Participants were encouraged to join community-based exercise programs when the SPA classes ended.

HP classes—The goal of the HP curriculum focused on encouraging participants to maintain a healthy lifestyle, and to engage in regular activities designed improve mood and reduce stress. Content for the classes were drawn from health promotion and problem-solving treatments for depression that were developed and tested in community-based primary care settings. [40, 41] Participants in the health promotion groups discussed a variety of age-appropriate topics in weekly classes including strategies to enhance motivation to engage in healthy behaviors, increase participation in pleasant events, and develop a daily relaxation practice (see Table 2). Sessions encouraged group discussion, using questions and examples from participants' personal experiences. Written handouts and goal setting assignments accompanied each topic. Participants set individualized personal health promotion goals and used checklists to monitor their progress that were reviewed at each session. No exercise routines were introduced, practiced, or recommended.

SPA+HP classes—The SPA+HP curriculum covered each of the topics in SPA and HP. Participants in this condition attended consecutive SPA and HP classes, and completed assignments and checklists for both exercise and health promotion goals.

RMC—Participants in RMC received routine care from their health care providers, including advice and support from their primary physicians and community support services. They were not provided with structured exercise recommendations, nor were they given health promotion information as part of this study. Outcome Measures

Primary Outcomes—*Self-rated health and mood* were rated using the Physical function, Role Physical, and General Health Perceptions subscales of the *SF-36 Health Status Survey*,[42] a widely used measure for physical and emotional health status;[43] and the *Geriatric Depression Scale* (GDS).[44]

Secondary Outcomes—Four categories of secondary outcomes were collected.

- **a.** Physical Performance was measured using the *6-Minute Walk Test*,[45] which assessed aerobic endurance by measuring the number of steps walked in 6 minutes. *Grip Strength* was measured in both hands using a hand-held Jamar dynamometer (Patterson Medical Products, Bollingbrook, IL). A total of 2 attempts in maximal effort were performed, and the average value in kilograms in the dominant was reported.
- **b.** Self-Rated Health and Health Behaviors were assessed with the *Physical Activity Scale for the Elderly (PASE)*,[46, 47] which rated frequency of participation in leisure, household, and work-related or volunteer activities during the previous week; the *Physician-based Assessment and Counseling for Exercise (PACE)*,[48] that

categorized participants into stages of exercise activity readiness, and self-reported *Exercise Minutes* ("During the past week, how much total time did you spend walking for exercise or doing other aerobic activity?").

c. Affective Function was assessed with: a) the *Psychological General Well-Being Index (PGWB)*;[49, 50] b) the *Perceived Quality of Life Scale (PQOL)*,[51] c) the *Penn State Worry Questionnaire (PSWQ)*,[52] and e) the Chronic Disease Self-Efficacy scales.[53].

d. Treatment Adherence was measured by monitoring class attendance, ratings of homework completion (not attempted, attempted, completed), and participant homework logs.

Adverse events—Participants completed an adverse symptom checklist at post-test and follow-up visits. All health status changes (illness, fall, hospitalization, or death) were reviewed by a data safety committee for determination of whether they were attributable to study participation.

Statistical Methods

The study was designed to have 80% power (alpha = 0.05, two-sided) to detect effect sizes of 0.4 SD for the SPA and HP treatment effects, assuming a 20% drop-out. Recruitment exceeded expectations, so there was greater than 90% power for this effect size at post-test and longitudinally.

Between-group comparisons of baseline covariates were conducted using Fisher's exact tests, t-tests, or non-parametric Kruskal-Wallis tests, as appropriate. Cox proportional hazards survival analyses were used to determine whether baseline characteristics predicted subject attrition.

Primary outcome analyses compared the four conditions using a 2 × 2 factorial design, with indicator variables for SPA and HP. The SPA effect was tested by comparing the mean difference between SPA and SPA+HP versus the HP alone and RMC. The HP effect was tested in an analogous manner (SPA+HP and HP alone versus SPA alone and RMC). This design assumed that the effect of the combined intervention would be equal to the sum of the effects of SPA and HP alone.

For the pre-post analyses, the outcome at the 3-month visit was regressed on the treatment conditions, controlling for baseline values:

$$\text{outcome}_{3\ \text{month}} = \text{intercept} + \text{SPA} + \text{HP} + \text{outcome}_{\text{baseline}} + \text{error}$$

These analyses were based on intent to treat (ITT), using all randomized participants. Baseline values were carried forward for participants missing the post-test. Longitudinal analysis used a repeated measures design, employing four post-treatment visits (3, 6, 12, and 18 months) and time, controlling for baseline values. Mixed models were used, with random effects for intercept and time, and an autoregressive correlation structure, which assumed that consecutive visits were more highly correlated than nonconsecutive visits:

$$\text{Measure}_{3,6,12,18} = \text{intercept} + \text{SPA} + \text{HP} + \text{measure}_{\text{baseline}} + \text{time} + \text{error}$$

Time-by-condition interactions were assessed with the same model structure.

$$Measure_{3,6,12,18} = intercept + SPA + HP + measure_{baseline} + time^{*}SPA + error$$

The primary longitudinal analyses used all available data for each subject.

A series of supplemental analyses were conducted to assess the robustness of randomization and model assumptions. Pre-post analyses were repeated without imputation for missing post-tests, and potential outcome confounders (baseline exercise, BMI, depression, age, gender, and marital status) were evaluated by entering baseline values one at a time as covariates in the appropriate models, and noting changes in the estimated treatment effect. Next, "dose" variables for SPA and HP based on attendance and homework completion were used in place of the SPA and HP effects. Finally, an SPA−HP interaction term was introduced into the primary models to test the validity of the additive assumptions underlying the SPA+HP intervention. A similar series of secondary analyses were conducted for the longitudinal analyses, including analyses only on participants with 18 months of follow-up.

RESULTS

Preliminary analyses revealed no significant pretreatment group differences on subject demographics except for marital status (Table 1), which did not affect the significance of any outcomes.

Baseline health status of participants

At baseline, 25% of participants had fallen or nearly fallen during the past 2 weeks, 33% complained of moderate to very severe pain, 28% had body mass index levels in the obese range (BMI ≥ 30), 66% had systolic blood pressure in the hypertensive range (> 140), 21% had elevated total cholesterol (> 200), and 14% had elevated hemoglobinA1c levels (> 6). Thirty percent were mildly to moderately depressed (Geriatric Depression Scale > 11). Twenty-five percent of participants reported no exercise during the prior week and 35% exercised less than 1 hour/week.

Participant study adherence

Of 273 participants who began the study, 258 (95%) completed the 3-month assessment, 239 (88%) completed the 12-month assessment, and 218 (80%) competed the 18-month assessment (Figure 1). There were no significant differences in rates of attrition between the treatment conditions. The only significant predictor of attrition was that subjects with post-high school education were less likely to withdraw.

At 12 months, adherence to all three active treatment conditions was excellent. Participants attended 72% of classes during the active 9 session intervention period, and 63% of the five monthly or quarterly booster sessions. Eighty percent of all exercise-related homework was turned in during the active treatment period, and 51% of participants continued to complete activity forms on their own, throughout the entire follow-up period. Seventy-five percent of all health promotion homework was turned in throughout the treatment period. There were no significant differences in adherence based upon gender or age.

3-month ITT analyses

Primary outcomes—At the 3-month assessment (Table 3), participants in SPA and SPA +HP reported significantly better general health perceptions on the SF-36 ($p<.05$) and a trend for improvement in physical function (SF-36; $p=.054$) than subjects not assigned to an

exercise condition (HP or RMC participants). There were no significant differences on the GDS for any treatment condition.

Secondary outcomes—Participants in SPA and SPA+HP also reported significantly more exercise minutes ($p<.05$), better muscle strength and endurance (PASE; $p<.05$), and improvements in quality of life (PQOL; $p<.05$), general wellbeing (PGWB; $p<.05$), perceived self-control (PGWB; $p<.01$), and vitality (PGWB; $p<.05$) (Table 3). There was a trend for improvement in emotional well-being (PGWB; $p=.055$). Participants who received health promotion education (SPA+HP or HP alone) reported worrying significantly less than those in SPA alone or RMC (PSWQ 1.7 points lower (3.3, 0.1); $p<.05$).

3-month supplemental analyses

When analyses were repeated without imputation (i.e., including only participants with post-test data), all findings were stronger than the primary ITT results. No covariate changed the significance of outcome variables in the ITT analyses, nor were there differences in affective outcomes for subjects with higher levels of baseline depression (GDS > 8). Participants in the SPA and SPA+HP conditions who had better attendance and rates of homework completion had better scores on anxiety, general and emotional health, and performed significantly better on the 6-minute walk.

18-month longitudinal outcomes

Primary outcomes—At 18 months, participants in SPA and SPA+HP maintained improvements in general health perceptions (SF-36; $p<.001$), and reported significantly better physical function on the SF-36 ($p<.01$) (Table 4). No significant differences on the GDS were obtained.

Secondary outcomes—Over 18 months, participants in the two SPA conditions continued to report more weekly exercise minutes ($p<.05$) than those in HP or RMC (Table 4). Furthermore, participants in SPA and SPA+HP maintained improvements in quality of life (PQOL; $p<.001$), general wellbeing (PGWB; $p<.01$), perceived self-control (PGWB; $p<.01$), and vitality (PGWB; $p<.05$), compared to HP and RMC participants. In addition, several new significant differences between SPA and SPA+HP compared to HP and RMC emerged. SPA and SPA+HP participants walked significantly more (PASE; $p<.05$), took significantly more steps on the 6-minute walk ($p<.05$), and reported greater exercise willingness (PACE; $p<.01$) than HP or RMC participants. Additional affective benefits included significantly lower worry scores (PSWQ; $p<.01$), and less depression and increased positive well being on the PGWB ($p<.05$) for SPA and SPA+HP than for HP and RMC. The effect of HP in reducing worrying was not maintained in longitudinal analyses. Appendix 1 (online table) shows the means and standard deviations for all outcome variables included in Tables 3 and 4 at all four sampling points.

18-month supplemental analyses

Supplemental analyses confirmed the primary results. When longitudinal analyses were repeated for the 218 participants who completed 18 months of follow-up, no baseline covariate changed the significance of outcome variables. When the dose of the interventions was evaluated, participants in the SPA and SPA+HP conditions with higher rates of adherence showed better scores on SF-36 physical and mental health, PASE muscle strength and endurance, lower anxiety, and higher self Efficacy (depression and social/recreational subscales) than HP and RMC participants.

In the final set of supplemental analyses, a SPA−HP interaction term was introduced into the primary models to test the validity of the additive assumptions underlying the SPA+ HP intervention. The additive assumptions were not supported.

Adverse Events

Only one minor adverse event was attributed to the intervention (an allergic reaction to the elastic tubing). There were three deaths unrelated to treatment reported (2 deaths from lung cancer and colon cancer after the 1-year followup, and 1 death from unknown causes at post test).

DISCUSSION

This study investigated comparative efficacy of an exercise and health promotion intervention to improve physical and emotional functioning in sedentary older adults. We sought to develop a safe, easy-to-follow, exercise program that would help older adults with chronic illnesses to gradually increase their amount physical activity to recommended levels that could be maintained. Study results confirmed that participants actively participated in exercise training, attended classes, and complied with exercise directives. Study attrition at 18 months was only 20%, a rate considerably lower than some other community-based exercise interventions for older adults.[54] Furthermore, following conclusion of active treatment, they continued exercising at significantly higher rates than control subjects.

Our first hypothesis was that SPA participants would improve significantly on measures of self-reported health and mood, whereas HP participants would show improvements in mood, compared with participants receiving routine medical care. The first part of this hypothesis was confirmed. Participants in SPA or SPA+HP exercised more, reported better muscle strength and endurance, better general health and wellbeing, greater vitality, greater self control, and higher quality of life at 3-months than participants in HP or RMC, with most improvements maintained over 18 months. The second part of this hypothesis, that HP participants would demonstrate improved affect, was only partially supported. Over 18 months of follow up, participants in SPA and SPA+HP worried less, and had greater positive well being. However, the only significant difference that could be attributed to HP alone was less worry in the HP and SPA+HP conditions at the 3-month assessment. This difference was not maintained over 18 months.

Contrary to our hypotheses, there were no significant differences in depression for any treatment condition as measured by the GDS. This finding may reflect the fact that subjects did not have unduly high levels of depression at study entry (mean GDS = 10.9). Subjects did, however, report reduced depression symptoms on the PGWB over 18-months of follow-up.

Our second study question was whether outcomes would be enhanced by combining exercise with education in health promotion. We hypothesized participants receiving SPA +HP would experience significantly better outcomes than those receiving SPA only or HP only. This hypothesis was not supported. The addition of health promotion strategies did not enhance outcomes. SPA and SPA+HP were not significantly different, and each yielded significant gains compared to HP alone or routine medical care. Thus, it appears that the SPA treatment protocol was the “active ingredient” responsible for improvements seen in this investigation.

There are limitations to this study. Older adults with severe mobility limitations and those who were cognitively impaired or institutionalized were ineligible. Our sample also represented a fairly highly educated population. Consequently, results cannot be generalized

to non-ambulatory, cognitively impaired, or less educated older adults. Further study with these vulnerable populations is needed.

Second, our exercise intervention was conducted by trained interventionists, motivated and committed to helping participants succeed. Given the simplicity of our program, we believe that other trainers will be equally successful, but that remains to be shown.

Third, because assessments were conducted in community settings, including senior centers and retirement homes, testing conditions for the 6-minute walk varied widely from site to site. In light of this variability, we determined that the most constant way to report outcome data for this variable was number of steps rather than reporting distance walked. We recognize that this makes clinical interpretation of the 6-minute walk results more difficult.

Fourth, we acknowledge that all outcome measures were tested at p=0.05, which does increase our risk of multiple comparison type-I error. If the alpha level had been divided among the four primary outcomes, the primary longitudinal findings would still have been statistically significant, although the post-test results for the SF-36 General Health perceptions would not have been. As always, it will be important to confirm our findings in future investigations.

Last, of 969 potential participants who were invited to participate in the study, 551 declined. We have no way of knowing if those declining would have been eligible for the study, however, as in all studies of this nature, it is likely that those most needing such programs are least likely to enroll. As volunteers, it is also likely that those who did enroll were more highly motivated to participate in exercise than those who declined.

With these limitations in mind, this study indicates that relatively sedentary and/or chronically ill older adults benefited from and continued the SPA exercise program for 3 months of active treatment and for at least 15 months after formal treatment concluded (a total of 18 months). Recent reviews of the literature have called for exercise intervention trials that include older participants with chronic disease, assess health-related quality of life outcomes, and provide home-based programs.[5, 12, 55, 56] In the SPA study, we addressed each of these issues. We also avoided methodological weaknesses identified in earlier studies by developing and testing a systematic and structured approach to treatment that is sufficiently detailed to enable replication. Furthermore, we systematically evaluated the level of attendance and exercise adherence for 18 months, during and after active treatment.

Our goal was to determine whether a structured, systematic home-based program of simple-to-follow exercises and training in overcoming obstacles to exercise initiation and maintenance would be successfully implemented with relatively sedentary older adults, and if so, whether it would be successful in improving their physical health status when compared to routine health care. The results of this study support the efficacy of SPA with this at-risk elderly population. These results, coupled with program's strengths – it is inexpensive, requires no specialized or costly equipment, is easy to implement, and was well received – make SPA a viable and potentially powerful evidence-based intervention to be implemented in community settings.

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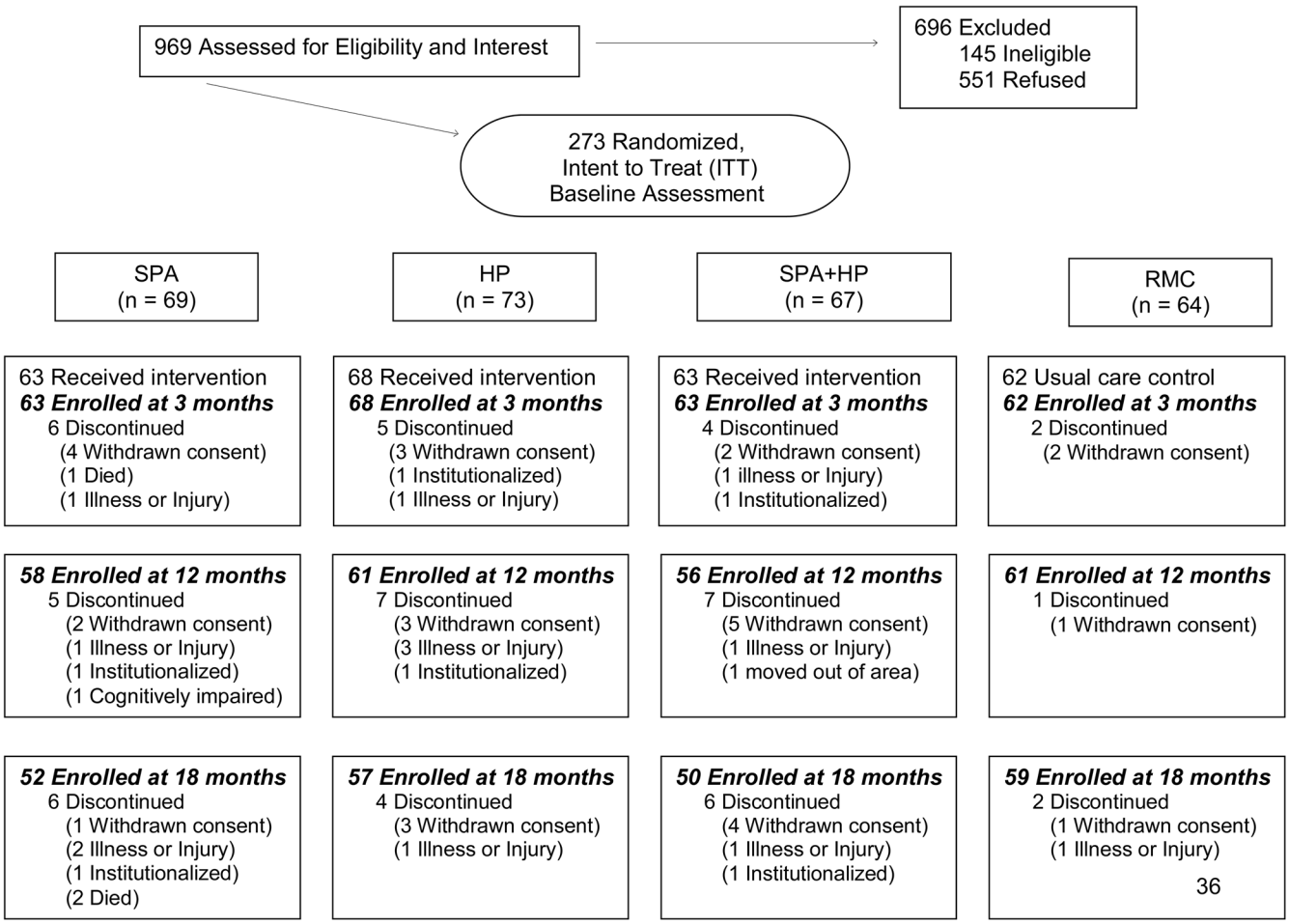

Figure 1.
Flow of participants through the trial.

Table 1

Baseline characteristics of participants.*

	SPA† (n=69)	HP (n=73)	SPA+HP (n=67)	RMC (n=64)	TOTAL (n=273)
Age (mean (± SD))	80.3 (6.1)	79.6 (4.6)	78.3 (5.3)	78.3 (4.2)	79.2 (5.2)
Gender					
Male	39.1%	34.3%	43.3%	35.9%	38.1%
Female	64.1%	65.7%	56.7%	64.1%	61.9%
Education					
Less than high school	4.3%	5.5%	6.1%	3.1%	4.8%
High school	13.0%	19.2%	18.2%	17.2%	16.9%
Post high school	82.6%	73.5%	75.8%	79.7%	78.3%
Marital status					
Married	30.4%	41.1%	59.7%	43.8%	43.6%
Widowed	40.6%	43.8%	28.4%	39.1%	38.1%
Divorced, separated or never married	29.0%	15.1%	11.9%	17.2%	18.3%
Ethnicity					
White, not Hispanic	89.9%	89.0%	91.0%	92.2%	90.5%
Asian/Pacific Islander	5.8%	2.7%	1.5%	3.1%	3.3%
Black, not Hispanic	4.4%	5.5%	6.0%	3.1%	4.8%
Hispanic	-	-	1.5%	-	0.4%
Native American	-	1.4%	-	1.6%	0.7%
Multiracial	-	1.4%	-		0.4%

*Values are expressed as percentage unless otherwise indicated. All group comparisons $p>.05$ except for marital status, significantly different at $p<.007$ for marital status (percent married).

†SPA=Seattle Protocol for Activity; HP=Health Promotion; SPA+HP=SPA plus Health Promotion; RMC=Routine Medical Care

Table 2

Session topics for each active treatment condition.

Seattle Protocol for Activity (SPA)	Health Promotion (HP)
Introduction to aerobic/endurance exercises	Identifying and setting personal healthy habit goals, maintaining motivation
Introduction to upper & lower body strength (shoulder flexion, shoulder extension, quadriceps, hamstring curls) & flexibility (triceps stretch, neck stretch, hamstring stretch, quadriceps stretch) exercises	Rationale for increasing pleasant events to enhance mood, overcoming obstacles to regular meaningful activity
More upper and lower body strength (biceps curls, lateral pull down, hip flexion, hip extension) & flexibility (top and inside forearm stretch, hip flexor stretch, ankle/calf stretch) exercises	Progressive relaxation training and practice, development of a daily relaxation practice plan
Balance & coordination exercises	Nutrition for healthy aging
Achieving and maintaining exercise goals	Personal nutritional choices
Measuring your exercise progress	Maximizing memory in daily life
Maintaining your momentum	Life long learning
Making exercise fun	Review and looking ahead
Progress in exercise and looking ahead	Communication
Maintenance & healthy living	Advance planning
Home exercise equipment	Safety: Home, driving, medication
Community resources	Enhancing personal resources
Exercise videos	Review of year's goals & termination
Wrap up and one year celebration	Introduction to active goal setting

Table 3

Significant SPA effects* at post-test (3-months), with baseline values imputed for missing post-tests.

Measure	Mean difference (95% CI)	p-value†
Primary Outcomes		
SF-36 Health Status Survey - General Health Perceptions	2.5 (0.4,4.6)	.018
Secondary Outcomes		
Self-Rated Health and Health Behaviors		
Exercise minutes, past week	39.3 (0.2,78.4)	.049
Physical Activity Scale for the Elderly – Muscle strength, endurance (scaled score)	0.13 (0.01,0.24)	.027
Affective Function		
Perceived Quality of Life	2.3 (0.2,4.4)	.030
Psychological General Well-Being Index (PGWB)	3.3 (0.3,6.2)	.030
PGWB – Self-Control	1.0 (0.2,1.7)	.009
PGWB – Vitality	0.8 (0.0,1.5)	.040

*Main exercise effects from the 2 × 2 design, indicating participants in SPA and SPA+HP were significantly better than HP and RMC subjects on outcomes shown.

†P-values for SPA from mixed effects linear models of the form:

$$\text{measure}_{3\ \text{month}} = \text{intercept} + \text{SPA} + \text{HP} + \text{measure}_{\text{baseline}} + \text{error}$$

Mean differences are the coefficients of SPA in this model, and represent the effect of the SPA intervention, controlling for HP and the baseline value of the outcome.

Table 4

Significant longitudinal SPA effects.*

Measure	Mean Difference (95% CI)	p-value†
Primary Outcomes		
SF-36 Health Status Survey - Physical Functioning	2.9 (0.9, 4.9)	0.005
SF-36 Health Status Survey - General Health Perceptions	3.0 (1.4, 4.7)	< 0.001
Secondary Outcomes		
Physical Function		
6-minute walk (steps)	28.4 (6.7, 50.1)	0.011
Self-Rated Health and Health Behaviors		
Exercise minutes, past week	31.4 (4.7, 58.1)	0.022
Physical Activity Scale for the Elderly (PASE)–Walking (scaled score)	0.08 (0.01, 0.15)	0.029
Physician-based Assessment and Counseling for Exercise (PACE)	0.4 (0.1, 0.7)	0.003
Affective Function		
Perceived Quality of Life (PQOL)	2.3 (1.0, 3.7)	0.001
Penn State Worry Questionnaire (PSWQ)	−1.6 (−2.7, −0.5)	0.004
Psychological General Well-Being Index (PGWB)		
Total Score	3.2 (1.0, 5.5)	0.004‡
General Health	0.5 (0.1, 0.9)	0.017‡
Self-Control	0.5 (0.1, 1.0)	< 0.001‡
Depression	0.4 (0.1, 0.7)	0.020
Positive Well-Being	0.6 (0.1, 1.1)	0.016
Vitality	0.7 (0.1, 1.2)	0.019

*Main exercise effects from the 2 × 2 design, indicating participants in SPA and SPA+HP were significantly better than HP and RMC subjects on outcomes shown.

†P-values for SPA from mixed models, using 3, 6, 12, and 18-month data. SPA, HP, and baseline values were fixed effects, and time and the intercept were random effects.

$$\text{Measure}_{3,6,12,18} = \text{intercept} + \text{SPA} + \text{HP} + \text{measure}_{\text{baseline}} + \text{time}^{*}\text{SPA} + \text{error}$$

Mean differences are the coefficients of SPA in this model, and represent the average effect of the SPA intervention, controlling for HP and the baseline value of the measure.

‡These are the p-values for the SPA main effect in models that included significant time by SPA interactions in which the SPA effect decreased over time for all three measures.

$$\text{Measure}_{3,6,12,18} = \text{intercept} + \text{SPA} + \text{HP} + \text{measure}_{\text{baseline}} + \text{time}^{*}\text{SPA} + \text{error}$$

The mean differences in the table represent the average effect of the SPA intervention, which was larger at initial visits and declined over time.

Appendix 1

Means (SD) for SPA outcome data statistically significant at post test or longitudinally.

	Group	Baseline Mean (± SD)	3 month Mean (± SD)	12 month Mean (± SD)	18 month Mean (± SD)
N	No EX[†]	137	130	122	116
	EX	136	126	114	102
Exercise minutes, past week	No EX	96.9 (90.5)	147.3 (162.7)	141.5 (134.1)	152.1 (167.4)
	EX	113.5 (111.8)	198.0 (202.1)	178.1 (209.2)	149.7 (162.4)
6-minute walk, steps	No EX	706.6 (132.4)	701.5 (147.1)	691.9 (163.3)	682.5 (154.3)
	EX	702.1 (157.1)	730.7 (156.1)	745.6 (113.3)	730.3 (97.6)
Patient-centered Assessment and Counseling for Exercise (PACE)	No EX	4.1 (1.9)	4.3 (1.9)	4.2 (2.1)	4.1 (2.0)
	EX	4.0 (1.8)	4.6 (1.8)	4.5 (2.0)	4.4 (2.3)
Physical Activity Scale (PASE), Muscle Strength, Endurance	No EX	0.10 (0.21)	0.14 (0.40)	0.31 (0.45)	0.40 (0.54)
	EX	0.11 (0.29)	0.27 (0.57)	0.43 (0.57)	0.42 (0.60)
Perceived Quality of Life Scale	No EX	78.9 (15.0)	79.5 (15.7)	79.8 (16.1)	79.6 (14.9)
	EX	79.7 (15.1)	82.1 (13.9)	80.9 (13.0)	80.7 (13.5)
Penn State Worry Questionnaire (PSWQ)	No EX	34.8 (11.0)	34.4 (12.1)	34.4 (12.5)	34.0 (11.9)
	EX	33.9 (9.6)	33.2 (10.6)	32.3 (10.5)	32.0 (9.4)
Psychological General Well-Being (PGWB)	No EX	68.7 (16.0)	72.6 (16.7)	84.1 (14.9)	82.9 (14.9)
	EX	70.3 (15.3)	77.6 (17.6)	84.6 (13.8)	83.8 (15.8)
PGWB Depression	No EX	11.3 (2.3)	11.9 (2.2)	13.2 (2.2)	13.4 (1.9)
	EX	11.2 (2.4)	12.3 (2.4)	13.4 (1.8)	13.3 (2.2)
PGWB Self-Control	No EX	8.7 (3.8)	9.5 (4.0)	12.7 (2.2)	12.9 (2.0)
	EX	9.1 (4.2)	10.9 (4.0)	12.8 (2.1)	12.9 (2.2)
PGWB Vitality	No EX	10.5 (3.8)	11.3 (4.0)	13.5 (3.7)	13.4 (3.4)
	EX	10.6 (3.8)	12.2 (4.1)	13.8 (3.3)	13.4 (3.7)

	Group	Baseline Mean (± SD)	3 month Mean (± SD)	12 month Mean (± SD)	18 month Mean (± SD)
PGWB General Health	No EX	8.4 (3.0)	9.0 (2.8)	10.4 (2.8)	10.0 (3.0)
	EX	8.8 (2.7)	9.8 (3.0)	10.6 (2.7)	10.3 (3.2)
PGWB Positive Well-Being	No EX	11.8 (2.8)	12.2 (3.2)	13.9 (3.5)	13.4 (3.7)
	EX	11.8 (3.0)	12.9 (3.7)	13.8 (3.6)	13.7 (3.4)
SF-36 General Health	No EX	70.2 (14.6)	69.4 (16.9)	69.2 (16.3)	68.1 (16.9)
Perceptions	EX	73.8 (15.8)	75.4 (14.2)	74.2 (14.9)	73.1 (15.4)
SF-36 Physical Functioning	No EX	67.8 (23.2)	66.7 (23.8)	67.4 (24.1)	65.0 (24.9)
EX	68.1 (22.8)	69.9 (22.8)	70.4 (25.4)	69.9 (24.9)	

†*Data shown are for outcomes in the 2 × 2 factorial design analyses, testing the difference between subjects receiving exercise (SPA and SPA+HP) compared to the non-exercising conditions (HP and RMC).

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