Original Research: Randomized Controlled Trial

A Randomized Controlled Trial to Determine the Efficacy of Sign Chi Do Exercise on Adaptation to Aging

Carol E. Rogers, PhD, RN; Colleen Keller, PhD, RN; Linda K. Larkey, PhD, CRTT; and Barbara E. Ainsworth, PhD, MPH

ABSTRACT

Sedentary older adults are at risk of decreased physical function that may lead to loss of independence. In addition, low spirituality is associated with all-cause mortality for older adults. Published research studies have not evaluated the effects of spirituality following a meditative movement intervention such as Sign Chi Do (SCD). The Roy Adaptation Model guided the design of a 12-week intervention that tested the effects of SCD compared with a minimal education control group on physiological and self-concept adaptation. Sixty-seven sedentary, community-dwelling older adults were randomized to the SCD or control group. Final analysis included 49 participants after adjusting for dropouts and incomplete data. Measurement of physiological (Timed Up & Go [TUG], 6-minute walk [6-MW], and MET-minute/week **[Query #1: Please spell out MET.]**) and self-concept (Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being-12 and Exercise Self-Efficacy) adaptation were completed at baseline (Time 1), 6 (Time 2), and 12 (Time 3) weeks. TUG and MET-minute/week scores improved significantly from Time 1 to Time 3 for the intervention group, and 6-MW at Time 3 showed a significant between-group difference of 271.36 feet. Self-concept measures did not yield significant results. These results indicate that the theoretical factor of Roy's physiological adaptation (balance and physical function) improved in response to the SCD intervention among sedentary older adults.

National guidelines recommend that older adults participate in some form of physical activity, regardless of their age, weight, health problems, or ability in order to increase or maintain physical function and **[Query #2: Should we add "avoid" here?]** other sequelae of sedentary behaviors (Nelson et al., 2007; U.S. Department of Health and Human Services, 2008). The effects of sedentary behaviors are reversible with moderate exercise, which enhances physical function and reverses loss of skeletal muscle mass (Spirduso, Francis, & MacRae, 2005). Physical activity that uses large lower extremity muscle groups as well as balance and coordination training are most beneficial for improving physical function and adaptation to aging among sedentary older adults (Davis, Donaldson, Ashe, & Khan, 2004).

Spiritual beliefs and confidence in the ability to participate in physical activity are critical factors in adaptation to aging. Positive spirituality and confidence in ability to participate in physical activity are important to the initiation and maintenance of physical activity for older adults (Musick, Traphagan, Koenig, & Larson, 2000; Rogers, Keller, & Larkey, 2010). Physical activity options suitable and effective for maintaining health and independence in older adults are mind-body exercises termed *meditative movement,* which includes tai chi, qigong, yoga, and Sign Chi Do (SCD) (Jahnke, 2002; La Forge, 2005; Rogers, 2010). SCD, developed by Dr. Anne Borik, a board-certified doctor of internal medicine with a background in exercise physiology, incorporates sign gestures with movement and rhythmic breathing coordinated with the movement (Borik, 2004).

Research that examines the efficacy of meditative movement exercise has focused primarily on tai chi and can be

used to extrapolate the potential efficacy of SCD. Tai chi, a close relative of SCD, has demonstrated improvements in age-related decline, including improved indicators of balance, physical function, psychological well-being, and self-efficacy (Rogers et al., 2010; Rogers, Larkey, & Keller, 2009).

Despite some very clear evidence of the efficacy of tai chi on functional outcomes in older adults, there are limitations in the reported research. For example, there is a lack of theoretical underpinnings guiding tai chi as an intervention; not all of the research reviewed discussed the inclusion of all elements of meditative movement; most of the studies did not screen for sedentary behavior; and participants included mostly healthy older adults who were able to stand and ambulate without assistive devices. Further, none of the reported research explored the effects of meditative movement on spirituality—an important component of healthy aging (Eisenhandler, 2005; Rogers et al., 2009). Thus, there is a need to examine the salient gap in the research that uses meditative movement as a form of physical activity and to test the effects of both physical movement and a spiritual or meditative component on functional outcomes in older adults.

MIND-BODY PHYSICAL ACTIVITY AND ADAPTATION

The Roy Adaptation Model (Roy, 2009; Roy & Andrews, 1999) was used to provide the theoretical rationale to guide the SCD intervention. The model suggests that adaptation to aging hinges on physiological- and self-concept-related factors that are demonstrated as effective in promoting physical activity among populations who have been inactive (John, 2007; Rogers & Keller, 2009; Young-McCaughan et al., 2007). Outcomes are measured as adaptive (i.e., promoting the integrity of the human system) or ineffective (i.e., neither promoting or contributing to the integrity of the human system) responses (Roy, 2009). The variables of interest were physiological and self-concept modes of adaptation. It was theorized that the physical movements from the SCD intervention would improve physiological adaptation and that the flow of the movement with rhythmic breath and concentration on positive word phrases with continued practice over 12 weeks would improve self-concept adaptation.

SCD employs slow, continuous movements of the arms and legs, postural alignment, concentration, and weight shifting with a low center of gravity purported to strengthen lower extremity and core muscles (Borik, 2004). Physiological changes expected to respond to physical aspects of SCD were improved balance and physical function.

Self-concept adaptation is the composite of beliefs, including spirituality and feelings, one has of oneself at a given time (Roy & Andrews, 1999). Awareness of the personal self, consciousness, and meaning are transformed when the person and environment integrate via thinking and feeling. A growing body of knowledge supports the importance of positive spirituality and religion among the aging population (Crowther, Parker, Achenbaum, Larimore, & Koenig, 2002; Eisenhandler, 2005; Flood, 2005; Koenig, 2006; Nelson-Becker, 2005). Meditation is described as a spiritual exploration that is correlated with positive health outcomes, including positive psychological attitude and prevention of health decline (Lindberg, 2005; Ospina et al., 2007). Spiritual meditation emphasizes positive spirituality as opposed to the negative consequences often associated with organized religious practice (Crowther et al., 2002).

The second outcome of self-concept adaptation is exercise self-efficacy. Self-efficacy is the confidence a person feels in performing a behavior and overcoming the associated barriers (Baranowski, Perry, & Parcel, 2002). Several studies have reported a significant positive relationship between physical activity and self-efficacy (r = 0.30 to 0.70

Dr. Rogers is Hartford Center of Geriatric Nursing Excellence Postdoctoral Fellow, Dr. Keller and Dr. Larkey are Professors, Arizona State University, College of Nursing and Health Innovation, Phoenix, and Dr. Ainsworth is Professor, Healthy Lifestyle Research Center, Program in Exercise and Wellness, Arizona State University, College of Nursing and Health Innovation, Mesa, Arizona.

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Address correspondence to Carol E. Rogers, PhD, RN, Hartford Center of Geriatric Nursing Excellence Postdoctoral Fellow, Arizona State University, College of Nursing and Health Innovation, 500 N. 3rd Street, Phoenix, AZ 85004; e-mail: Carol.Rogers@asu.edu.

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and $b = 0.497$) **[Query #4: Is "*b*" correct, or should it be β (beta)?]** (Gallagher, Jakicic, Napolitano, & Marcus, 2006; McAuley et al., 2006; Netz, Wu, Becker, & Tenenbaum, 2005 **[Query #5: Please reference this citation.]**). In older adults who are sedentary, self-concept adaptation is characterized by decreased spirituality and confidence in the ability to exercise.

Self-concept-related factors were selected based on understanding the unique role of mind-body physical activity in shifting older adults toward a more meaningful sense of self and, specific to SCD, a grounding in spiritual connection. SCD, as a form of meditative movement, focuses on the meaning of positive word phrases with the intention of eliminating "chatter" in the brain, while focusing on the flow of the movement and the rhythm of the breath to achieve a meditative state (Borik, 2004; Wu, 2002). SCD word phrases are taught in a three-step pattern (**Table 1**). Thus, with intention and repetition, this pattern promotes spiritual meditation. Self-efficacy is enhanced in four ways: demonstration of the SCD movement, seeing the SCD movements performed by others, repeating the SCD movements themselves, and increasing daily participation in the SCD movements. Self-concept was assessed to determine whether personal beliefs were adaptive or ineffective. Self-concept changes expected to respond to this mind-body physical activity were spirituality and exercise self-confidence.

PURPOSE

The purpose of this article is to describe the results from a study examining the efficacy of SCD on adaptation to aging among a sample of sedentary, community-dwelling older adults 55 and older, compared with a minimal education waitlist control group. The specific aims were to evaluate the efficacy of SCD, compared with the control group, on the physiological (function) and self-concept (spirituality and self-efficacy) modes of adaptation among the sample at baseline (Time 1), 6 (Time 2), and 12 (Time 3) weeks and to determine effect size for future study of SCD on improved function and personal self-concept adaptation. The research questions were:

- What is the effect of SCD on physiological/physical function adaptation, as measured by balance with the Timed Up & Go (TUG) score and function with the 6-minute walk (6-MW), physical activity recall (PAR), and pedometer steps?
- What is the effect of SCD on self-concept adaptation as measured by spirituality with the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being-12 (FACIT-Sp-12) and self-efficacy with the Exercise Self-Efficacy scale (ESE)?

METHOD

Design

A randomized experimental design with repeated measures was used (SCD or minimal education control), with one between-subjects treatment factor (12-week SCD intervention versus minimal education control) and two within-subjects time factors (Times 1, 2, and 3). Measurement time points were selected because prior studies demonstrated significant changes in outcome parameters at 3 months (Taggart, 2002; Wolf et al., 2003). The midpoint measure was to determine whether there was a peak effect.

Sample and Screening

From five large senior centers in a metropolitan area in the southwestern United States, 135 older adults were screened, with 67 meeting inclusion criteria of age between 55 and 89, acceptable cognitive level on the Mini-Cog (Borson, Scanlan, Chen, & Ganguli, 2003), sedentary (less than 60 minutes planned physical activity per week) with accompanying compromise to physical function, ability to participate in light- to moderate-intensity physical activity, and ability to speak English. The age for inclusion was set at 55 based on recommendations from the senior centers' advisory board with the rationale that sedentary retired adults participating in programs at the centers are at the same risk for loss of physical function as those 65 and older. Cognitive function was assessed with the Mini-Cog (Borson et al., 2003), and individuals who scored within the acceptable range were allowed to participate in the study.

To determine physical activity in the past week, each participant, using a form created for this study, was asked the type and how many minutes of planned or scheduled physical activity they performed. The TUG (Podsiadlo & Richardson, 1991) was used to determine physical function, and all participants were screened with the Physical Activity Readiness Questionnaire (Canadian Society for Exercise Physiology, 1998) **[Query #6: Please confirm this questionnaire is contained in this publication.]** to rule out those at risk for an adverse event during exercise. Written physician permission to participate in the study was obtained if a participant responded *yes* to one or more of the questions.

For this study, sample size was set at 60 (30 per group) with alpha = 0.05, power = 0.80, and an expected effect size

TABLE 1

Sign Chi Do Intervention Used in This Study

<table>
<tr><td colspan="4">• Begin with warm up.
• Initial form is taught from seated position, then standing. Participants are to stand beside their chairs for safety reasons. If needed, the chair is there for balance. Those who cannot stand are asked to contract leg muscles in place of the stepping forward movement and relax when stepping back.
• Practice all movements on right first, then left, to create balance.
• Repetition of movements is key.</td></tr>
<tr><td>Warm up 5-10 minutes.</td><td>Begin with a deep breath and raise arms in front of body, exhale as arms lower. Next breath, raise arms to side as inhale and lower as exhale.</td><td>Next do five forward and backward shoulder rolls, followed by arm circles, front and back.</td><td>Place one hand on opposite shoulder. Raise elbow to shoulder height. Open opposite hand with palm facing ceiling and place under elbow. Lower elbow while giving resistance with hand under elbow. Inhale as you raise elbow and exhale as you lower with resistance. Repeat five times.</td></tr>
<tr><td>All movements begin with postural alignment (sitting or standing): Shoulders relaxed and in alignment with hips and feet and all facing forward. When standing, feet start shoulder-width apart. [Query #7: Is this correct as placed here to introduce the stances? If it should be moved back to the warm up (above), please provide new text here to introduce the stances.]</td><td>Front-leaning stance: Step forward one stride length, toes first and facing forward as knee bends. Maintain feet shoulder-width apart. Opposite foot, toes slightly turned out (30°) and leg straight. Shift weight to back foot. Bend back knee and straighten front knee when shifting weight to back foot. Both feet remain flat on floor at all times. Connect breath and arms with leg movements (as weight shifts forward, raise arms and take in a deep breath; as shifting back, exhale). Repeat 5-10 times as able. As legs strengthen, may increase stepping distance.</td><td>L stance: Step back with one foot, making an L with feet (creating a 90° angle). Feet should be a comfortable distance apart, and the heel of the back foot should land in line with front foot. Shift weight to back foot, and front foot should be settled on heel with toes pointing up in the air. Most of weight is on the back foot with knee bent and front knee straight. Shift weight from back to front foot and bend front knee as back knee straightens. Connect breath and arms with leg movements (as weight shifts forward, raise arms and take in a deep breath; as shifting back, exhale). Repeat 5-10 times as able.</td><td>One-leg stance: Plant one foot firmly on floor. Fix gaze on wall in front of you to assist with balance. Hold onto chair and raise opposite leg, creating a 90° angle at knee. Hold as long as possible. Once conditioned to this movement, add by tucking foot behind knee of the supporting leg. Repeat two to three times initially and increase repetitions as able.</td></tr>
</table>

of 0.65 **[Query #8: Is sentence OK as edited?]** (Cohen, 1988). Study recruitment was conducted with an anticipated 30% dropout rate ($N = 72$), consistent with physical activity programs in this population (Li et al., 2005; Sattin, Easley, Wolf, Chen, & Kutner, 2005; Taggart, 2002). When recruitment began at the last site, the cumulative dropout rate postrandomization was 11% ($n = 6$), with 56 participants enrolled, and the decision was made to stop recruitment.

Recruitment, Randomization, and Retention Strategies

The study was approved by the University's Institutional Review Board. Strategies for recruitment included scheduled presentations to senior center participants, demonstration of SCD during lunch announcements, and posting flyers at the sites. Efforts were made to recruit a sample representative of the older metropolitan ethnic population (64% White, 21% Hispanic, 15% Other) by recruiting from two senior centers with an ethnically diverse population. All interested participants signed consent to participate in the study prior to baseline data collection. Following completion of baseline measures, participants were randomly assigned to the SCD or control group by site using a 2 × 2 block group method using a random sequence number generator.

TABLE 1 (CONTINUED)

Sign Chi Do Intervention Used in This Study

Example of three sign gesture movements: Physical form includes isometric and isotonic muscle contractions balanced with muscle relaxation. Practice from seated position, then standing, incorporating a modified front-leaning stance.	Healthy: Bring hands to chest with palms open. Extend arms forward in a powerful manner with hands clenched into fists as muscles in forearm and upper arm tighten, assuming the boxer's posture. Hold form for a count of four or follow timing of music.	Breath: Breathe in as hands are placed on chest. Breathe out as arms are extended.	Intention of word: Imagine strength or power emanating from the body. This move suggests that not only the body, but also mind and soul are healthy. Practice with music and repeat three to four times.
	Happy: Roll hands upward and outward, starting low in the abdomen. This rolling motion is continuous.	Breath: Breathe in as hands move in a continuous motion rolling outward. Breathe out with the continuous motion.	Intention of word: The sign gesture shows emotion at the level of the gut. Imagine a belly laugh.
	Holy: The right index and middle finger (the H sign) glide across the palm of the left hand, extending upward and outward on an angle.	Breath: Breathe in as the right fingers are placed on the palm of left hand. Breathe out as fingers brush across palm and extend upward and outward.	Intention of word: Imagine wiping away or cleansing the slate. Allow self to feel connected as extend arm upward.
Learn movements with a three-step process	First, learn physical form of the sign gesture (engaging the body).	Second, visualize what the phrase means (engaging the mind).	Third, feel the word phrase (engaging the emotional and spiritual exploration).
Meditative effects	Intention of practice: set aside time to practice with purpose and thought.	Attention: feeling and visualizing the meaning of the word phrase.	Attitude: without judgment but recognition of feelings experienced.
Spirituality/deep state of relaxation and overall well-being enhanced via:	Body movement or posture.	Focus on breath.	Clearing of the mind through the focus on meaning of the sign gesture.

[Query #9: Please confirm this content is original to this article and has not been published elsewhere.]

To support retention in the study, all participants were compensated with a $10 gift card following completion of each data collection session. Telephone calls were used to remind participants of scheduled data collection times. For the SCD group, attendance rosters were checked weekly. If a participant missed a class, he or she received a telephone call in an effort to bring the participant back on schedule as soon as possible, identify the reason for the absence, resolve possible problems, and review content missed in class. Control group participants received biweekly newsletters and were offered the 12-week SCD intervention after the initial 12-week data collection period.

Intervention Structure

A detailed protocol guide was written to structure the SCD intervention. One-hour weekly sessions included groups of 5 to 10 participants each, over 12 weeks. Each session included a 5-minute warm-up and cool-down time and 50 minutes of instruction and participation in SCD, according to the protocol established by Borik (2006). **Table 1** provides a detailed description of the intervention components.

Warm-up movements consisted of isotonic movements of arms and weight-shifting stances of the legs. Participants who were unable to stand were asked to perform movements from a seated position and visualize performance of the movements from a standing position. For safety, all participants stood beside a chair to maintain stability. SCD word phrases were taught in the three-step pattern: *do* the movement, *visualize* what the phrase means, and *feel* the word phrase. While the physical form of each word phrase is defined by the facilitator, each participant is encouraged to create his or her own visual representation and feeling of the word phrase. This is intended to promote spiritual

exploration.

Weekly instruction included four phrase-based routines during the first 6 weeks, more complex movements to familiar songs such as "God Bless America" and "Let There Be Peace on Earth" **[Query #10: Please reference these songs according to APA 6th edition format or remove the specific song titles.]** for the next 4 weeks, and 2 weeks of review. The songs selected were appropriate for this population as they are sung by the community members prior to lunch at all of the senior centers. Participants were given a copy of an instructional DVD, music CD, flash cards, and a personal assessment log to facilitate practice of movements at home between classes. Word phrases for each class were demonstrated and written on a grease board **[Query #11: Do you mean "white board"?]** in the classroom. Participants were encouraged to practice at least 10 minutes, two times between classes the first week, increasing the time to include up to the recommended 30 minutes, 5 days per week, and record their weekly practice in the activity log.

Intervention Fidelity

Two certified SCD instructors **[Query #12: If these are authors, please provide the initials.]** with more than 4 years of experience taught the intervention classes; their instruction was observed and rated by an expert in SCD **[Query #13: If this is an author, please provide the initials.]** for consistency. The classes were taught according to the intervention manual. Instructors completed weekly checklists regarding completion of program content, and random class sessions were videorecorded. These recorded sessions were reviewed for adherence to program content and process and were scored according to the observation forms for fidelity. Fidelity was reported to be 100%, indicating the intervention was delivered as designed.

Minimal Education Control Group

Participants in the minimal education control group received biweekly newsletters that addressed age-appropriate health topics covering food safety, polypharmacy, smoking, vitamins, oral health, and influenza vaccine during the 12-week intervention time to maintain interest in the study. They were also contacted by the investigator every 4 to 6 weeks to schedule data collection meetings. The content of the newsletters contained no "active ingredients" of the SCD intervention.

Study Variables

Measurement of study variables occurred at baseline (Time 1), midpoint (6 weeks, Time 2), and completion of the program (12 weeks, Time 3), according to procedures detailed in the SCD protocol manual. Participants completed the measures at the same time points. Demographic variables included age, gender, chronic illnesses, education, height, weight, and race/ethnicity.

Outcome Variables. Outcome variables included valid and reliable measures to evaluate changes in physiological/physical function and self-concept modes of the Roy Adaptation Model. Physical function was measured using objective and subjective performance measures, and self-concept was measured with self-report psychometric scales. Physiological function was operationalized as balance measured by the TUG, and physical function was measured by the 6-MW, PAR, and pedometer steps. Self-concept was operationalized as spirituality and measured by the FACIT-Sp-12, and self-efficacy was measured with the ESE.

The TUG is a multifaceted measure of balance. It measures in seconds the time it takes one to stand from a seated position, walk 10 feet, turn, return to the chair, turn, and sit down (Podsiadlo & Richardson, 1991). The 6-MW is a safe measure of functional status for older adults, measuring the distance in feet one can walk in 6 minutes (Harada, Chiu, & Stewart, 1999). Weekly physical activity was measured by a self-report PAR record and represented physical activity exclusive of SCD practice during the intervention. The PAR was adapted from the Stanford 7-Day Recall developed for use in epidemiological research to assess physical activity (Blair et al., 1985). Weekly physical activity recorded on the PAR was scored by multiplying the minutes of activity by its associated MET value to calculate a MET-minute score (Ainsworth et al., 2000). Each MET-minute score was summed per week to create MET-minute/week. Participants were also given a pedometer (NL-2000, New-Lifestyles, Inc., Lees Summit, MO) to wear for 1 week at each data collection point. The NL-2000 is an objective measure of physical activity and was used to confirm the self-report PAR scores by comparing the reported amount of accumulated physical activity in MET-minute/week to the amount of activity recorded on the pedometer in steps (Schneider, Crouter, & Bassett, 2004).

Spirituality was measured with the FACIT-Sp-12 (Peterman, Fitchett, Brady, Hernandez, & Cella, 2002). Following an extensive literature search, this subscale was determined to be the most appropriate measure to capture the conceptual definition of spirituality used in this study. For example, items include perceptions of life satisfaction, assessment of comfort and strength from spiritual beliefs, and peace of mind. The 12 survey items use a 5-point Lik-

ert scale ranging from 0 (*not at all*) to 4 (*very much*); the possible range of scores is 0 to 48.

Exercise self-confidence was measured with the ESE, which measures individuals' beliefs in their ability to accumulate 30 minutes of physical activity per day on 5 or more days per week in the future (McAuley et al., 2006). On a scale of 0 **[Query #14: Should this be "0%"?]** (*not confident*) to 100% (*highly confident*), participants were asked to indicate how confident they were they could continue to exercise in the future from 1 week to 8 weeks.

Manipulation Checks and Adherence. Participants in the SCD class completed exit surveys. Questions on the surveys asked how active they were before and after the class and whether the class improved their strength and balance. All responses were scored on a 5-point Likert scale from *not at all* to *extremely*. To monitor adherence, attendance at class sessions was reported as percentage of attendance at class sessions by week and the number and percentage of sessions attended by participant. Reasons for missed classes were also reported.

TABLE 2

Demographic Data for the Sample (*N* = 49)

	Intervention Group (*n* = 26)	Control Group (*n* = 23)
Variable	**Mean (*SD*)**	**Mean (*SD*)**
Age	73.65 (8.43)	76.52 (7.99)
Years of education completed	13.12 (4)	12.87 (3)
Number of chronic diseases	3.15 (1.57)	3.74 (1.54)
Height (inches)	63.57 (3.11)	63.15 (3.23)
Weight (pounds)	184.66 (44.42)	190.22 (48.86)
	***n* (%)**	***n* (%)**
Gender		
Women	24 (92)	18 (78)
Men	2 (8)	5 (22)
Race/ethnicity		
White	22 (85)	19 (83)
White Hispanic	3 (14)	5 (26)
African American	2 (8)	2 (9)
American Indian or Alaska Native	2 (8)	1 (4)
Asian	0 (0)	1 (4)
Chronic disease[a]		
Cardiac	20 (77)	20 (87)
Arthritis/orthopedic	18 (69)	16 (70)
Chronic pain	14 (54)	11 (48)
Cancer	7 (27)	6 (26)
Diabetes	6 (23)	11 (48)
Respiratory	5 (19)	9 (39)
Other	12 (46)	14 (61)

Note. Percentages may not total 100 due to rounding.
[a] Participants could select more than one.

[Query #15: Please note the White Hispanic category was further indented under White to represent a subgroup of that race. Also, the percentages were recalculated as a percentage of the White race choice.]

[Query #16: Should "Asian" be "Asian American"?]

Statistical Analysis

Data were entered into SPSS version 18 and verified via double entry prior to analysis. A table of descriptive statistics was created for demographic data. Analysis of frequencies; mean, median, and mode; and kurtosis and skewness for all data was performed. Based on Levine's Test of Equality of Error Variances, MET-minute, pedometer steps, and spirituality total scores were log transformed. To determine baseline demographics and outcome variables, *t* tests and chi-square tests were performed between the SCD intervention and minimal education control groups, and those who completed and dropped out.

To describe the associations between variables, a table of Pearson's correlations between demographic variables and outcome variables was created. Analysis of FACIT-Sp-12 and ESE scores included: Cronbach's alpha coefficient, kurtosis, skewness, and correlations. The primary analysis for main effects was a repeated measures analysis of variance, with one between factor of assignment to intervention or control group and one within factor of time to determine changes in physiological and self-concept adap-

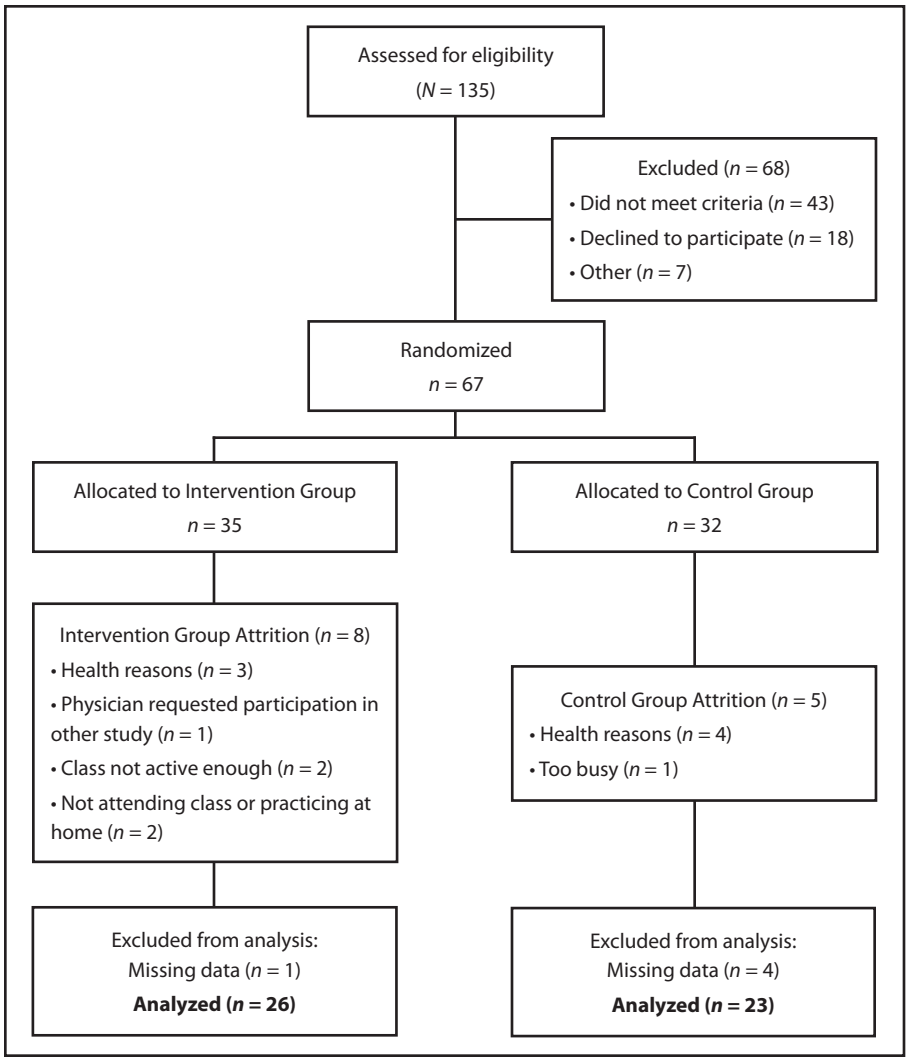

Figure. Flowchart detailing selection and attrition of participants.

tation. Time within group for significant TUG and MET-minute and between group simple effects for significant 6-MW main effects were explored using procedures outlined by Maxwell and Delaney (2004). Weekly physical activity in MET-minutes and pedometer steps were analyzed using Spearman's correlation to determine the association between the subjective and objective measures of physical activity. Cohen's *d* was calculated at postintervention (Time 3) to examine final effect size (Cohen, 1988).

FINDINGS

Sample Description

Sixty-seven older adults were enrolled in the study, and 49 completed all assessments. Their average age was 75 (*SD* = 8.27 years, age range = 62 to 88). Participants were mostly White (84%), with some African American (8%), American Indian or Alaska Native (6%), and Asian (2%); 16% were of Latino ethnicity. Most participants were women (86%) and had completed at least 1 year of college education **[Query #17: Please provide the percentage here.]**. Participants were of average height (mean = 63.37 inches, *SD* = 3.14) and generally overweight (mean = 187.27 pounds, *SD* = 46.15). Random group assignment produced balanced groups on all demographic factors as reported in **Table 2.** Spirituality was positively associated with 6-MW, MET-minutes/week, and ESE ($r = 0.278, 0.251$, and 0.247, respectively; $p < 0.05$). ESE was also positively associated with MET-minutes/week ($r = 0.390$, $p < 0.01$).

The CONSORT participant flowchart (Schulz, Altman, & Moher, 2010), with reasons for attrition listed by intervention and control group, is reported in the **Figure.** In this study, the attrition rate was 19%, with only 13 dropouts and 5 participants deleted from the final analysis due to missing data. No significant difference was found between those who completed the study versus those who dropped out for baseline measures except for spirituality scores. Means for spirituality were 38.56 (*SD* = 7.85) and 30.54 (*SD* = 12.65), $p = 0.005$, for completers and dropouts, respectively.

Physiological/Physical Function and Self-Concept Adaptation

Findings are reported for a total of 49 participants (intervention group, $n = 26$; control group, $n = 23$). Mauchley's Test of Sphericity was significant for TUG and spirituality, and the Greenhouse-Geisser adjustment for degrees of freedom were reported for these main effects. Levine's Test of Equality of Error Variances was not significant for all scores, except for MET-minute/week at Time 2 and for

TABLE 3

Main Effects and Group-by-Time Interaction of the Sign Chi Do Intervention (*N* = 49)

	Mean (*SD*)			*F* Ratio				
Item	Baseline (Time 1)	Week 6 (Time 2)	Week 12 (Time 3)	Group	Time	Group by Time	Partial Eta Squared	Cohen's *d*
TUG				2.528	9.83**	3.62*	0.173	–0.57
Intervention group	13.55 (4.7)	11.96 (3.82)	11.02 (3.17)					
Control group	14.16 (3.59)	14.50 (5.2)	13.28 (4.83)					
6-MW				4.409*	1.382	1.72	0.028	0.7
Intervention group	939.97 (293.84)	900.85 (339.26)	985.19 (339.55)					
Control group	791.22 (374.36)	719.74 (365.16)	713.96 (447.86)					
PAR				0.004	6.28*	0.56	0.118	0.2
Intervention group	6.00 (1.61)	6.64 (2.15)	7.17 (1.71)					
Control group	6.13 (1.61)	6.80 (0.83)	6.82 (1.78)					
FACIT-Sp-12				1.059	2.2	0.22	0.045	0.27
Intervention group	3.64 (0.2)	3.70 (0.16)	3.69 (0.19)					
Control group	3.60 (0.27)	3.62 (0.27)	3.64 (0.23)					
ESE				0.22	0.17	1.92	0.004	–0.38
Intervention group	67.93 (26.69)	65.10 (31.5)	60.43 (36.34)					
Control group	66.36 (29396)	64.89 (37.73)	73.42 (31.18)					

Note. TUG = Timed Up & Go (i.e., time in seconds it takes one to stand from a seated position, walk 10 feet, turn, return to the chair, turn, and sit down); 6-MW = 6-minute walk (i.e., the distance in feet one can walk in 6 minutes); PAR = physical activity recall (i.e., minutes of weekly physical activity converted MET-minutes, which in turn were summed per week to create MET-minute/week); FACIT-Sp-12 = Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being-12 (Peterman, Fitchett, Brady, Hernandez, & Cella, 2002), scored 0 = *not at all* to 4 = *very much*; ESE = Exercise Self-Efficacy scale (McAuley et al., 2006), scored 0 = *not confident* to 100% = *highly confident.*

Intervention group, $n = 26$; Control group, $n = 23$. Group ($df = 1, 47$) and Time and Group by Time interactions ($df = 2, 94$), except TUG (1.67, 78.535) and FACIT-Sp-12 (1.58, 74.125) **[Query #18: Is sentence OK as edited and *df* placed correctly?]**. Natural log transformed scores reported for PAR and FACIT-Sp-12.

* $p < 0.05$; ** $p < 0.001$.

[Query #19: Regarding the Control Group's ESE scores at Time 1, please provide the correct standard deviation.]

spirituality at Times 1 and 2. All MET-minute/week and spirituality scores were log transformed to adjust for these unequal variances in the analysis. Actual change scores were reported in addition to the log transformed scores to provide a meaningful finding. Mean scores, standard deviations, *F* ratio, Cohen's *d,* and partial eta square for all main effects and interactions are reported in **Table 3.**

Physiological/Physical Function Adaptation. There was a significant main effect of time on TUG and MET-minutes/week, group differences for 6-MW, and a significant interaction for week by group for the TUG measures of physiological adaptation (**Table 3**). Pairwise comparisons were completed to explore direction and significant changes by group assignment. A significant decrease was found in TUG scores from Time 1 to Time 2 (–1.59, $p = 0.003$) and Time 1 to Time 3 (–2.53, $p = 0.000$) for the intervention group. For the control group, there was no significant change in TUG scores from Time 1 to Time 2 (0.34, $p = 0.53$) or Time 1 to Time 3 (–0.872, $p = 0.203$). Pairwise comparisons among time within groups showed a significant increase in MET-minutes/week for the intervention group between and Time 1 and Time 3 (1.178, $p = 0.001$). The actual change score was 1512.71. Actual mean and standard deviation scores for weekly MET-minutes were 769 (*SD* = 738), 1,752 (*SD* = 1,481), and 2,282 (*SD* = 1,672) for the intervention group, and 824 (*SD* = 699), 1,234 (*SD* = 1,026), and 1,778 (*SD* = 1,643) for the control group (Time 1, Time 2, and Time 3, respectively). For the 6-MW, there was a significant mean difference of 271.236 feet between groups at Time 3, $F(1, 47) = 5.785$, $p = 0.02$. The trend was an increase for the intervention group, while the control group decreased distance walked.

Pedometer. Many participants chose not to wear pedometers every day; however, 36 participants wore them at least 3 days per week. After averaging scores as described in the Method section, there were complete weekly scores for 43 participants at Time 1, 37 at Time 2, and 36 at Time 3. Due to multiple missing scores, pedometer data were not included in the overall repeated measures analysis. Pedometer data were compared to physical activity MET-minute scores to determine whether a significant association existed between the two variables. The Time 1 scores were not significantly correlated, but Time 2 and Time 3 scores were positively correlated (Spearman's rho = 0.338 and 0.373, $p < 0.05$, respectively). The actual untransformed step means were 24,365 (*SD* = 11,221), 28,213 (*SD* = 11,472), and 23,641 (*SD* = 13,210) for the intervention group, and 21,627 (*SD* = 10,175), 19,947 (*SD* = 11,184), and 20,631 (*SD* = 14,509) for the control group.

Self-Concept Adaptation. No significant changes were found for either measure of self-concept, spirituality, or self-efficacy **[Query #20: Is sentence OK as edited?]**. For spirituality, actual mean scores were 38.92 (*SD* = 6.77), 40.731 (*SD* = 5.61), and 40.857 (*SD* = 6.923) for the intervention group, and 37.747 (*SD* = 9.111), 38.587 (*SD* = 9.124), and 38.846 (*SD* = 8.148) for the control group (Time 1, Time 2, and Time 3, respectively). The median score at each data collection time point for spirituality was more than 40, with a maximum score of 48. Exploration of the ESE scores showed approximately 50% of the scores ranged from 80 to 100, with 100 as the maximum possible score.

Manipulation Checks and Adherence. Eighty-five percent of the participants self-reported an increase in their level of activity from before to after the SCD intervention. Many were some or moderately active before class (mean = 2.41, *SD* = 1.85), and this changed to moderate to very active after the 12 weeks (mean = 3.52, *SD* = 0.89). The participants reported moderate changes in strength (mean = 3.04, *SD* = 1.06) and some to moderate improvements in balance (mean = 2.89, *SD* = 1.21).

Of those who completed the intervention, there was an overall 69% attendance rate. An examination of weekly attendance indicated the following: Week 1, 100%; Week 2, 70.4%; Week 3, 59.3%; Week 4, 66.7%; Week 5, 74.1%; Week 6, 63%; Week 7, 63%; Week 8, 66.7%; Week 9, 63%; Week 10, 70.4%; Week 11, 70.4%; and Week 12, 66.7%. Intervention dosage to determine the percentage of participants who completed all 12 sessions included 27 participants. **[Query #21: Please clarify, as the intervention group had only 26 participants.]** Seven participants attended 8 total sessions, 5 attended 11 sessions, 4 attended 10 sessions, 4 attended 9 sessions, 3 attended 7 sessions, 2 attended 5 sessions, and 2 attended only 4 sessions. **[Query #22: Please note Figure 2 was converted into this sentence, as it was unclear how to interpret the data in the graph. Is it OK as added?]**

Health care needs (primarily illness or health care provider visit) was the most frequent reason for missing sessions. The remaining non-health care reasons included forgot to come to class, family needs, conflicting event at senior center, working at senior center, vacation, or lack of transportation.

Effect Size

The calculation of effect size is critical to future intervention design. The calculated effect sizes were medium for the TUG and 6-MW ($d = -0.57$ and 0.7, respectively) and small for PAR, pedometer steps, spirituality, and ESE ($d = 0.2$, 0.22, 0.27, and –0.38, respectively). **[Query #23: Please clarify why pedometer steps are not listed in Table 3.]** Further interventions should have a sample of 100 to achieve power of 80 with a medium effect size to report changes in physiological adaptation measured by TUG and 6-MW. In this study, the attrition rate was 19% with only 13 dropouts; future studies should plan for a 19% attrition rate.

DISCUSSION

After completing the SCD intervention, participants in the intervention group significantly improved on measures of physiological adaptation (TUG and MET-minute/week) within the group, with significant between-group difference at Time 3 for 6-MW. No significant differences were found for self-concept adaptation; however, the baseline scores were high. The improvements in physiological measures indicate a shift from ineffective to adaptive outcomes for SCD participants in the physiological adaptation mode. The high baseline scores for self-concept measures indicate participants were adaptive in this mode, according to the definition established by Roy (2009), and there was no need to change.

This is the first study to examine the efficacy of a 12-week SCD intervention on adaptation to aging among sedentary community-dwelling older adults; therefore, the findings were compared with previous tai chi research. Participants in this study were nearer the oldest-old age range, mostly women, and White with some Hispanic ethnicity; more than half reported a history of four or more chronic diseases; and all reported risk of functional decline and

sedentary behaviors. Previous research using tai chi interventions reported the average age of participants included younger older adults (67.76 [**Query #24: Is this the mean age?**]) and fewer women (71.97%) (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010; Rogers et al., 2009, 2010). When ethnicity was reported, participants were mostly White, and no studies included Hispanic participants. Further, most of the participants in the reported literature were healthy older adults and were excluded if they reported multiple chronic illnesses; many of the studies required participants to stand independently to enroll in the class (Rogers et al., 2009). For this SCD intervention, participants were allowed and encouraged to participate in classes from a seated position or to maintain support using assistive devices including holding onto a chair when standing to maintain stability.

Physiological/Physical Function

The intervention group improved for the 6-MW at Time 3, whereas the control group decreased, indicating that a loss of function over time may be attributed to their sedentary behavior. The reported improvement in physical function for the intervention group in this study is consistent with previous studies of similar forms of exercise, such as tai chi, as reported in an earlier comprehensive review (Rogers et al., 2009).

Dose. In similar studies, the TUG showed significant reductions in time for completion among tai chi participants compared with control groups (Gatts & Woollacott, 2006; S. Yeh, Chuang, Lin, Hsiao, & Eng, 2006). The pattern of change for the 6-MW in the current study, reporting significant differences between the 12-week SCD intervention and control group, was the same for similar research, but with higher between-group differences (Pippa et al., 2007; G.Y. Yeh et al., 2004). Those studies generally used a more intensive delivery schedule, meeting two to five times per week for up to 6 months compared with this 12-week intervention that met 1 day per week. Participants were expected to practice independently between classes, but there was no way to confirm practice outside of class. Further examination of the potential of SCD should evaluate effective intervention dose and frequency.

Measurement Differences. The lack of a significant main effect difference between the intervention and control groups for the TUG in this study may indicate that the TUG is a less sensitive measure of improvement among a sedentary population with low starting levels of function. Rather than measure improvements, a more realistic expectation in this aging population may be to measure prevention of further decline in function. Nevertheless, there was a trend in the expected direction.

Baseline Differences. There are possible explanations for why the intervention used in this preliminary study did not achieve the same amount of increased distance walked in 6 minutes as other research. Differences may be related to the lower baseline scores for the population used in the current study compared with Pippa et al.'s (2007) and G.Y. Yeh et al.'s (2004) studies (870, 1293, and 1094 feet, respectively), indicating that lower starting levels of endurance may indicate less capacity for improvement. Inclusion criteria for this SCD intervention targeted individuals with lower levels of physical function than other tai chi research studies, and more than half of our participants reported multiple chronic conditions. This may be explained by comparing participants in other research using tai chi who were healthy older adults, able to walk independently, and had limited chronic conditions. In addition, the participants in the current study were nearer the oldest-old age range and mostly women compared with participants in Pippa et al.'s (2007) and G.Y. Yeh et al.'s (2004) studies.

Physical Activity. The significant increase in the MET-minutes/week of physical activity performed between Time 1 and Time 3 for the intervention group was supported by the manipulation check. Levels of physical activity were typically not reported in research literature on meditative movement. One study did report a significant increase in weekly physical activity in a tai chi group compared with a sedentary control group among 95 older adults with a history of coronary artery disease (Stenlund, Lindström, Granlund, & Burell, 2005).

Self-Concept

Demonstration of the SCD intervention most likely recruited individuals who self-identified as spiritual and were confident they could perform the movements. However, spirituality was positively associated with higher 6-MW distance walked and physical activity. In other research, statistically significant improvement of spirituality was reported following participation in an 8-week mindfulness-based stress reduction program among 44 adults (mean age = 47.8) (Carmody, Reed, Kristeller, & Merriam, 2008). The meditative component of that intervention was similar to the SCD meditative component; however, the baseline scores were significantly lower than those reported in the current study. Further, participants in that intervention were younger than those in this intervention. Participants who dropped out of the study reported significantly lower spirituality scores.

LIMITATIONS

This work shows that SCD facilitates an adaptive improvement of functional outcomes in sedentary community-dwelling older adults as theorized. This intervention does have several limitations. First, the small sample limits generalizability of the findings to the population and perhaps limits the power to detect significant differences between groups on a number of outcome variables. Second, multiple comparisons were used. **[Query #25: Is sentence OK as edited?]** Finally, the data collected did not control for changes in medical treatment of chronic disease. What remains to be explored are the dose and frequency to enhance efficacy, as well as the mechanism of change to mental and physical processes attributed to the spiritual meditation component of SCD.

CONCLUSION

[Query #26: Please provide a brief summary/conclusion for your article (approximately 150 words).]

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