Yoga for HEART

(Health Empowerment and Realizing Transformation)

Intervention to Enhance Motivation for Physical Activity in Older Adults

by

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ABSTRACT

Cardiovascular disease (CVD) is the leading cause of mortality in the U.S. While physical activity can reduce CVD risk, most adults do not engage in adequate physical activity to maintain or improve health. Older adults are less likely to participate in physical activity and experience a greater burden of CVD compared to younger adults. Despite knowledge of motivators and barriers to physical activity, the challenge to reduce cardiovascular risk in the older adult population remains unmet. Older adults face unique and complex barriers to physical activity, including limited social contextual resources and behavioral change processes. Interventions to enhance wellness motivation have demonstrated potential in promoting health behavior change among older adults.

The purpose of this study was to examine the feasibility of the Yoga for HEART (Health Empowerment and Realizing Transformation) Intervention to increase motivation for physical activity and improve cardiovascular health in older adults. A pilot randomized controlled trial design was used. The Intervention group received Yoga for HEART, a 12-week program to foster motivation for health behavior change. The Control group received a 12-week group yoga program that did not contain theory-based components. The intervention was based on Wellness Motivation Theory, conceptualizing health behavior change as dynamic process of intention formation and goal-directed behavior leading to the development of new and positive health patterns. Critical inputs (i.e., empowering education, motivational support, social network support) were designed to promote social contextual resources and behavioral change processes to increase motivation for physical activity and improve cardiovascular health.

Specific Aims were to: (a) examine intervention acceptability, demand, and fidelity, and (b) evaluate intervention efficacy in promoting physical activity and improving cardiovascular health through increased social contextual resources and behavioral change processes. Participants in the Intervention group realized a significant reduction in body mass index (BMI) from baseline to 12 weeks when compared to participants in the Control group. Intervention group participants demonstrated improvement in theoretical mechanisms (i.e., self-knowledge, motivation appraisal, self-regulation, environmental resources) and intended outcomes (i.e., body composition) when compared to Control group participants. Findings from this study support the feasibility of the Yoga for HEART Intervention in older adults.

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INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality in the United States and worldwide (Benjamin et al., 2017; World Health Organization [WHO], 2017). Despite our understanding of the factors and behaviors that promote ideal cardiovascular health, the prevalence of CVD continues to rise, and is projected to increase over time as the population ages (Benjamin et al., 2017). Older adults experience a disproportionate burden of CVD and related chronic health conditions, including hypertension, diabetes, and dyslipidemia (Benjamin et al., 2017).

The Healthy People 2020 national health agenda highlights the importance of physical activity to promote healthy aging and reduce disparities in cardiovascular health among older adults (Office of Disease Prevention and Health Promotion [ODPHP], 2017). The American Heart Association (AHA), the American College of Sports Medicine (ACSM), and the National Institute on Aging (NIA) at the National Institutes of Health (NIH) recommend that older adults participate in regular physical activity to promote cardiovascular and overall health (Nelson et al., 2007; U.S. Department of Health and Human Services [USDHHS], 2017). Despite established benefits, few older adults engage in adequate amounts of physical activity to maintain or improve health (Ward, Clarke, Nugent, & Schiller, 2016).

This Chapter provides an overview of the social and economic burden of CVD in the United States, the impact of CVD on older adults, the role of physical activity in promoting cardiovascular health in older adults, and the strengths and limitations of research in this field. Yoga is presented as an innovative approach to promoting physical

activity and cardiovascular health in older adults. The chapter will conclude with specific aims that include testing a theory-based yoga intervention to enhance motivation for physical activity and improve cardiovascular health in older adults.

The Social and Economic Burden of Cardiovascular Disease in Older Adults

The demographic profile of the United States is projected to change dramatically by the middle of the century, with the proportion of older adults increasing more rapidly than any other age group. Data from the U.S. Census Bureau indicate that the number of adults ≥ 65 years of age will almost double, from 43.1 million in 2012 to 83.7 million in 2050 (Ortman, Velkoff, & Hogan, 2014). The anticipated shift in population aging will be accompanied by an increased burden of CVD, the leading cause of death in the United States (Benjamin et al., 2017).

Cardiovascular disease (CVD), a broad diagnostic term encompassing hypertension, atherosclerosis, heart disease, peripheral vascular disease, and stroke, disproportionately affects older adults (Benjamin et al., 2017). An estimated 92.1 million American adults have CVD; of these, 46.7 million are adults ≥ 60 years of age (Benjamin et al., 2017). Cardiovascular disease accounts for approximately 808,000 deaths annually in the United States, or 1 in every 3 deaths (Benjamin et al., 2017). Each day, about 2,200 American adults die from CVD, an average of 1 death every 40 seconds (Benjamin et al., 2017). Approximately 81% of CVD mortality occurs in adults ≥ 65 years of age (Benjamin et al., 2017).

As the population ages, the prevalence and costs of CVD are projected to increase substantially. The annual costs of CVD, including the direct costs of medical care and indirect costs due to lost productivity, totaled $555 billion in 2016 and are projected to

rise to $1.1 trillion by 2035 (American Heart Association [AHA], 2017). The increasing prevalence of CVD, its associated expenditures and losses, and its impact on well-being and quality of life contribute to the growing need for innovative approaches to cardiovascular health promotion and disease prevention across the lifespan.

Ideal cardiovascular health. The AHA Impact Goals for 2020 introduce the concept of ideal cardiovascular health, emphasizing behaviors and factors that promote cardiovascular health (Lloyd-Jones et al., 2010). This conceptual shift represents an expanded focus on health promotion and disease prevention, as it reframes health as a broader and more positive construct than merely the absence of disease (Lloyd-Jones et al., 2010). Ideal cardiovascular health is achieved through favorable health behaviors (meeting physical activity goals, maintaining a healthy body weight, consuming a healthy diet, and not smoking) and health factors (maintaining blood pressure [BP] < 120/80 mmHg, fasting blood glucose level < 100 mg/dL, and total cholesterol level < 200 mg/dL) (Lloyd-Jones et al., 2010).

Individuals who maintain ideal cardiovascular health into middle age have greater longevity, compression of morbidity, better quality of life, and lower healthcare costs into older age (Lloyd-Jones et al., 2010). However, the prevalence of ideal cardiovascular health remains low in the United States, including approximately 5% of the population (Lloyd-Jones et al., 2010). While the factors and behaviors that improve cardiovascular health have been identified, the challenge of promoting sustained lifestyle change to achieve ideal cardiovascular health has not been met.

Physical Activity to Promote Cardiovascular Health in Older Adults

To promote ideal cardiovascular health and optimize healthy aging, the AHA, the ACSM, and the NIA recommend that older adults engage in a comprehensive program of physical activity involving exercises to promote endurance, strength, flexibility, and balance (Nelson et al., 2007; USDHHS, 2017). Federal guidelines suggest that health benefits may be achieved by accumulating at least 150 minutes of moderate-intensity physical activity per week, 75 minutes of vigorous-intensity physical activity per week, or an equivalent combination thereof (Nelson et al., 2007). Older adults should participate in muscle-strengthening activities on at least two non-consecutive days per week and those at risk for falls should incorporate balance-promoting exercises into their regular physical activity routine (Nelson et al., 2007; USDHHS, 2017).

Despite established health benefits, few older adults engage in adequate levels of physical activity to maintain or improve cardiovascular and overall health. National survey data indicate that less than 27% of older adults (≥ 75 years of age) meet federal guidelines for leisure-time aerobic physical activity, and fewer than 9% of older adults (≥ 75 years of age) meet guidelines for leisure-time aerobic and muscle-strengthening physical activity (Ward et al., 2016).

Older adults, members of racial and ethnic minority groups, and socioeconomically disadvantaged individuals have an increased prevalence of CVD and associated risk factors, including hypertension, diabetes, dyslipidemia, obesity, and physical inactivity (Benjamin et al., 2017). Across all age groups, women are less likely to meet federal guidelines for leisure-time physical activity (17%) compared to men (25%; Ward et al., 2016). Hispanic adults are less likely to meet physical activity guidelines (16%) than non-Hispanic white adults (23%; Ward et al., 2016). Lower levels

of education and income are associated with lower levels of leisure-time physical activity (Ward et al., 2016). These inequities in physical activity by age, gender, race, ethnicity, and socioeconomic status contribute to health disparities across the population.

Given that older adults face unique and complex barriers to engaging in physical activity, the development of innovative interventions to promote physical activity and improve cardiovascular health in older adults represents a public health priority. Healthy People 2020 objectives are aimed at eliminating disparities by increasing the proportion of older adults that participates in physical activity and decreasing the proportion that participates in none (OHPDP, 2017).

Yoga Interventions to Promote Cardiovascular Health in Older Adults

Yoga is a comprehensive type of physical activity and an ancient mind-body practice oriented toward optimal health and wellness (Iyengar, 2014). Yoga is practiced in a variety of styles that range from gentle to vigorous, making it particularly suitable for older adults with a range of health, fitness, and ability levels. Yoga includes physical postures (*asana*) as well as breathing exercises (*pranayama*) and relaxation or meditation (*dhyana*); each of these components has health benefits. While yoga interventions have demonstrated potential in promoting cardiovascular and overall health, few have targeted cardiovascular health outcomes in older adults.

Yoga practice has been shown to improve a range of cardiovascular health variables in younger adults, including blood pressure (BP) (Cohen et al., 2011; Lee, Kim, & Kim, 2012), body mass index (BMI; Bernstein, Bar, Ehrman, Golubic, & Roizen, 2014; Chu, Gotink, Yeh, Goldie, & Hunink, 2014), blood glucose (Hunter et al., 2013), and lipid profile (Lee et al., 2012). Yoga has been shown to improve mood (Streeter et

al., 2010), relieve stress (Innes & Selfe, 2012), promote well-being (Bryan, Zipp, & Parasher, 2012), and enhance quality of life (Pullen et al., 2010). Yoga may lead to favorable changes in strength (Kim, Bemben, & Bemben, 2012), balance (Tiedemann, O'Rourke, Sesto, & Sherrington, 2013), and flexibility (Gonçalves, Vale, Barata, Varejão, & Dantas, 2011), which are factors that encourage safe participation in physical activity and reduce the risk of falls in older adults (Schmid et al., 2012).

Despite the growing burden of CVD in older adults and the significant benefits to be achieved in reducing risk, there has been limited attention to yoga interventions aimed at improving cardiovascular outcomes in older adults. The challenge remains to synthesize findings from yoga intervention studies as a foundation for healthy aging research and practice. To promote cardiovascular health in older adults consistent with national health objectives, a greater depth of understanding regarding the structure and efficacy of existing yoga interventions is essential. Thus, the objectives of the following review were to (a) provide a comprehensive review and evaluation of yoga interventions designed to promote cardiovascular health in older adults; and (b) provide recommendations for future research in this area. A review of current yoga intervention research provides a starting point for determining salient approaches to intervention and evaluation, issues related to program implementation, and the strengths and limitations of existing approaches (Barrows & Fleury, 2016).

Literature review methods. A systematic review of the literature was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). Four electronic databases (PubMed, CINAHL, PsycINFO, and SPORTDiscus) were searched using the

following key words: older adults, yoga, physical activity, intervention, and CVD. Ancestry searches were conducted and journals were hand searched to retrieve additional records.

Titles and abstracts were screened for eligibility. Original research articles were considered for review based on the following criteria: (a) randomized controlled trial (RCT) design); (b) yoga-based intervention; (c) cardiovascular health outcomes measured; (d) sample mean age ≥ 60 years, and (e) published in an English-language, peer-reviewed journal. No restrictions were placed on publication date. Cardiovascular health outcomes included BP, BMI, blood glucose, and blood lipids consistent with AHA 2020 Impact Goals (Lloyd-Jones et al., 2010). Psychosocial and behavioral outcomes included self-efficacy and physical activity, as these process variables are essential to the initiation and maintenance of health behavior change (Artinian et al., 2010). Secondary health outcomes included endurance, strength, flexibility, and balance, as these factors may influence safe participation in physical activity among older adults (Nelson et al., 2007).

Results. Electronic database searches identified 283 articles. Ancestry and hand searches retrieved an additional 375 titles and abstracts. In total, 658 articles were identified, 76 duplicates were removed, and 582 titles and abstracts were screened for eligibility; 142 articles met criteria for full review. One hundred thirty-four articles were excluded following review, 71 due to sample age and 63 due to study design. A total of nine articles met eligibility criteria and were included in this review (Figure 1). Study characteristics are presented in Table 1 (Barrows & Fleury, 2016).

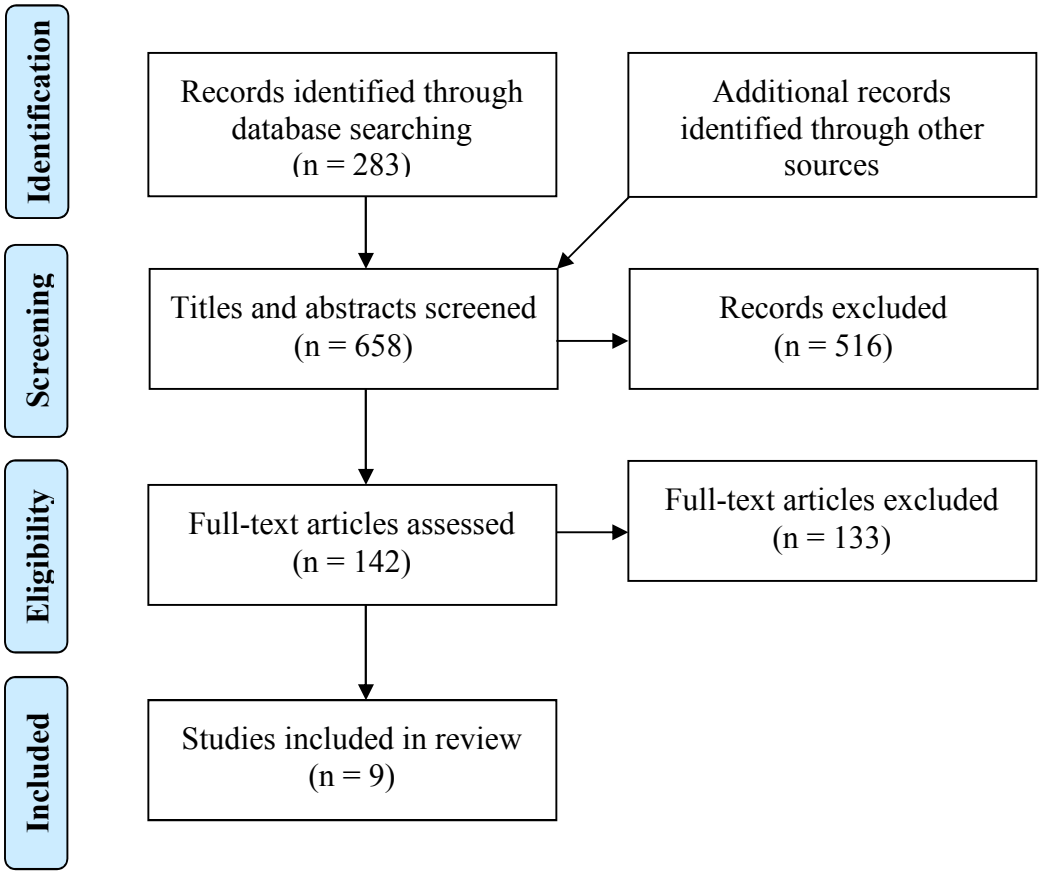

Figure 1. PRISMA flow diagram of literature review.

Table 1

Characteristics of Yoga Intervention Studies in Older Adults

First Author Year	Design Methods	Sample Setting	*N*	Age	Intervention	Outcomes	Notes
Chen 2008	RCT Quasi-experimental Cluster randomization by facility 3-arm intervention: 1) yoga A 2) yoga B 3) control Pre-post test: T1) baseline T2) 12 weeks T3) 24 weeks	Community-dwelling older adults Recruited from 8 senior activity centers in Taiwan 73% women (128/176) 43% completed HS (76/176) 62% married (109/176) 86% lived with family (151/176)	176 analyzed 189 (93%) completed 204 enrolled 13 (7%) omitted 2° attendance	m = 69 ± 6 range n/r < 60 years excluded	Yoga type: Silver Duration: 24 weeks Frequency: 3 sessions/week Length: 55 – 70 minutes Dose: 66 – 84 hours Total: 72 sessions Inclusion criteria: Older adults (≥ 60 years) Community dwelling No yoga experience Walk without assistance Cognitively intact (SPMSQ) Independent (BI ≥ 91)	Pulmonary function* Blood pressure* Body mass index* Body fat percentage Endurance* Strength Balance Flexibility* Range of motion* Gait speed* Adverse events: n/r Attrition: 7% Attendance: 88% ≤ 50% attendance = dropped from analysis Measures:	Complete 70-minute Silver yoga with guided imagery meditation (n = 57/64) compared to adapted 55-minute Silver yoga without guided imagery meditation (n = 53/59) and wait list control (n = 66/66) Yoga-based physical activity program to improve physical fitness in older adults

	78% physically active (137/176) 55% comorbidity (97/176) 98% did not use tobacco (172/176) 98% did not use alcohol (172/176)	Handgrip Sit and reach Chair stand One leg stand 6-meter walk Goniometry	Program design based on preliminary data from pilot intervention study Expert recommended, evidence-based, tested yoga intervention protocol Delivered by yoga interventionists trained and certified by investigator Yoga sessions guided by audiotape to enhance intervention fidelity

					Team approach (2 older staff members) Yoga intervention session components: 20 minutes of warm-up (8 postures) 20 minutes of yoga (7 postures) 10 minutes of relaxation (3 exercises) 15 minutes of meditation (2 exercises) Group sessions Participants per group not described

							(15 – 20 reported in Chen et al., 2009)
Chen 2010	RCT Quasi-experimental Cluster randomization by facility 2-arm intervention: 1) yoga 2) control Pre-post test: T1) baseline T2) 12 weeks T3) 24 weeks	Frail, transitional older adults Recruited from 2 assisted living facilities in Taiwan 53% women (29/55) 82% ≤ 6 years of education (45/55) 53% widowed (29/55) 58% physically active (32/55) 66% comorbidity	55 completed 69 enrolled	m = 75 ± 7 range n/r < 65 years excluded	Yoga type: Silver Duration: 24 weeks Frequency: 3 sessions/week Length: 70 minutes/session Dose: 84 hours Total: 72 sessions Inclusion criteria: Older adults (≥ 65 years) Frail and transitional No yoga experience Walk without assistance Cognitively intact (MMSE) Dependent (BI = 91 – 99)	Pulmonary function* Heart rate Blood pressure Body mass index Body fat percentage* Aerobic fitness Endurance Strength Power Balance Flexibility* Range of motion* Gait speed* Agility* Adverse events: n/r Attrition: 20% Attendance: 81% Measures: Handgrip	Silver yoga (n = 31/38) compared to wait list control (n = 24/31) Yoga-based physical activity program to improve physical fitness in older adults Program design based on preliminary data from pilot intervention studies Expert recommended, evidence-based, tested yoga

	(36/55) 80% did not use tobacco (44/55) 93% did not use alcohol (51/55)	Sit and reach Chair stand One leg stand 2-minute step 6-meter walk Goniometry Arm curl Back scratch	intervention protocol Delivered by yoga interventionists trained and certified by investigator Yoga sessions guided by audiotape to enhance intervention fidelity Team approach (2 older staff members) Yoga intervention session components:

							20 minutes of warm-up (8 postures) 20 minutes of yoga (7 postures) 10 minutes of relaxation (3 exercises) 15 minutes of meditation (2 exercises) Group sessions 12 – 13 participants per group
Donesky-Cuenco 2009	RCT Pilot 2-arm intervention: 1) yoga 2) control	Older adults with COPD Recruited by advertisements, physician referral, and support groups in California	29 completed 41 enrolled 210 screened	m = 70 ± 10 range n/r < 40 years excluded	Yoga type: Iyengar Duration: 12 weeks Frequency: 2 sessions/week Length: 60 minutes/session Dose: 24 hours Total: 24 sessions Inclusion criteria:	Dyspnea Aerobic endurance Walking distance* Physical function* Strength Quality of life Anxiety Depression	Yoga (n = 14/20) compared to usual care (wait list control) (n = 15/21) Yoga therapy program to improve physiological and psychological

	Pre-post test: T1) baseline T2) 12 weeks	72% women (21/29) 79% Caucasian (23/29) 86% had some college (25/29) 79% not employed (23/29) 24% married (7/29) 45% widowed or divorced (13/29) 55% lived with family (16/29)	123 excluded 46 declined	Adults (age > 40 years) Clinically stable COPD ADL limited by dyspnea $SpO_2 \geq 80\%$ during 6MWT No symptomatic illness (HD) No yoga/rehab past 6 mos.	Safety Feasibility Adverse events: n/r Attrition: 29% Attendance: 83% Measures: 6-minute walk test Cycle ergometry Isokinetic muscle test SF-36 S-FPI CES-D SSAI CRQ Semi structured exit interviews with participants	health and function in older adults with COPD Iyengar yoga-based intervention with individual modification, use of props Protocol developed by expert panel Intervention delivered by experienced instructors at a yoga studio affiliated with university integrative medicine

	83% did not use tobacco (24/29) 17% used oxygen (5/29)	Yoga postures, sequence, and rationale described Props including blankets, bolsters, blocks, and chairs were used to modify postures to meet individual needs Yoga intervention session components: 10 physical postures (*asana*) 2 breathing exercises (*pranayama*) Group sessions 3 – 7 participants per group

							Daily home practice encouraged Individual home practice documented Video provided to guide home practice
Fan 2011	RCT Quasi-experimental Cluster randomization by facility 2-arm intervention: 1) yoga	Older adults with dementia Recruited from 7 long-term care facilities in Taiwan 59% women (35/59)	59 completed 68 enrolled	m = 75 ± 7 range n/r < 60 years excluded	Yoga type: Silver Duration: 12 weeks Frequency: 3 sessions/week Length: 55 minutes/session Dose: 33 hours Total: 36 sessions Inclusion criteria: Older adults (≥ 60 years) Dementia diagnosis MMSE = 18 – 23 (m = 19)	Pulmonary function* Heart rate Blood pressure* Body mass index Body fat percentage Endurance* Strength* Flexibility* Balance* Gait speed* Range of motion* Depression*	Yoga (n = 30/33) compared to usual care (n = 29/35) Yoga-based physical activity program to improve physical and mental health in older adults with dementia

	2) control Pre-post test: T1) baseline T2) 12 weeks	86% had ≤ 9 years education (51/59) 87% married (51/59) 83% comorbidity (49/59)	Long term care ≥ 6 months No exercise past 6 months	Problem behavior* Adverse events: n/r Attrition: 13% Attendance: 95% Measures: Handgrip Sit and reach Chair stand One leg stand 6-meter walk Arm curl Back scratch 2-minute step CSDD	Program design based on preliminary data from pilot studies and RCTs Expert recommended, evidence-based, tested yoga intervention protocol Delivered by yoga interventionists using team approach (2 older staff members) Yoga intervention session components:

							20 minutes of warm-up (8 postures) 20 minutes of yoga (7 postures) 10 minutes of relaxation (3 exercises) Group sessions 9 – 13 participants per group
Gordon 2008	RCT 3-arm intervention: 1) yoga 2) exercise 3) control Pre-post test: T1) baseline T2) 12 weeks T3) 24 weeks	Community-dwelling adults with type 2 DM Recruited from an outpatient clinic in Cuba 81% women (186/231)	231 completed 2652 screened 2421 excluded	m = 64 range 40 – 70	Yoga type: Hatha Duration: 24 weeks Frequency: 1 session/week Length: 120 minutes Dose: 48 hours Total: 24 sessions Inclusion criteria: Adults (age 40 – 70 years) Diabetes D_x of 1 – 10 years No severe comorbidities	Fasting glucose* Lipid profile* Oxidative stress* Oxidative status* Attrition: 0% Attendance: 93%	Yoga-based physical activity (n = 77) compared to aerobic exercise (n = 77) and wait list control condition (n = 77) Yoga-based exercise therapy to promote health in adults with diabetes

		No tobacco or alcohol use Previous diabetic education	
	Participants matched by age, gender		Intervention guided by protocol designed and delivered by a physical and certified Hatha yoga instructor Daily home practice encouraged Individual home practice documented Illustrated booklet provided Yoga intervention session components: 20 minutes of breathing

							25 minutes of warm-up 60 minutes of postures 15 minutes of relaxation
Littman 2012	RCT 2-arm intervention: 1) yoga 2) control Pre-post test: T1) baseline T2) 26 weeks T3) 52 weeks Participants matched by age, BMI, stage of Ca^+	Overweight and obese breast cancer survivors Recruited from community-based settings and a cancer research registry in Washington 100% women (63/63) 94% NHW (59/63)	54 completed 63 enrolled 132 screened 63 eligible	m = 60 range 33 – 74	Yoga type: Viniyoga Duration: 26 weeks Frequency: 5 sessions/week Length: 20 – 75 minutes Dose: 67 – 124 hours Total: 130 sessions 1 to 3 group sessions/week 2 to 4 home sessions/week Goal: 5 total sessions/week Group sessions: 75 minutes Individual: 20 – 30 minutes Inclusion criteria: Adults (age 21 – 75 years) Ca^+ T_x complete ≥ 3 months	Body mass index Waist circumference Hip circumference Physical activity Fatigue Quality of life Feasibility Adverse events: n/r Attrition: 14% Attendance: 77% Participants who attended ≥ 24 classes noted significant	Yoga (n = 27/32) compared to wait list control (n = 27/31) Therapeutic yoga program to promote physiological and psychological health in overweight/obese cancer survivors Developed for cancer survivors and adults with chronic illness by trained, certified,

	95% had ≥ some college or professional degree (60/63) 62% annual income ≥ $60k (39/63) 49% were married (31/63) Physically active Varied yoga experience	Body mass index ≥ 24 kg/m^2 No DM, MI/CVA ≥ 6 months No pregnancy or plans for it No plans to relocate soon No current yoga practice No yoga contraindications	improvement in QoL and fatigue Measures: FACT-G Modifiable Activity Questionnaire	experienced yoga instructors Intervention guided by protocol with standardized manual to enhance fidelity Physical postures modified using props to adapt practice to individual needs Yoga mats and straps provided Props (blocks, blankets, chairs) available Regular home practice encouraged

				Individual practice documented CD, DVD, educational booklets provided Motivational interviewing techniques used to promote home/class adherence Key yoga postures were described Yoga intervention session components: 5 – 10 minutes of centering/relaxation 50 – 60 minutes of physical postures 10 – 15 minutes of breath/meditation

Skoro-Kondza 2009	RCT Exploratory 2-arm intervention: 1) yoga 2) control Pre-post test: T1) baseline T2) 12 weeks T3) 32 weeks	Community-dwelling adults with type 2 DM Recruited from clinical and fitness settings in 2 multi-ethnic boroughs in UK 61% women (36/59) 36% White British/European (14/59) Socioeconomic status varied, skewed towards deprived	59 completed	m = 60 ± 10 range n/r	Yoga type: n/r Duration: 12 weeks Frequency: 2 sessions/week Length: 90 minutes/session Dose: 36 hours Total: 24 sessions Inclusion criteria: Adults (age ≥ 18 years) Non-insulin dependent DM No serious comorbidities No major cognitive deficit English language proficiency	Blood pressure Body mass index Waist/hip ratio Blood glucose Lipid profile Quality of life Self-efficacy CV risk score Attrition: n/r Attendance: 50% Measures: ADDQoL MYMOP	Yoga (n = 29) compared to wait list control (n = 30) Yoga therapy intervention designed to promote health in adults with diabetes Intervention delivered by experienced yoga instructors and implemented in consultation with health expert panel Yoga postures adapted to meet individual needs and ability levels

							Yoga intervention session components: Postures Breathing Relaxation Group sessions Participants per group not described Recruitment posed challenges; physical and motivational barriers identified

Toise 2013	RCT Pilot 2-arm intervention: 1) yoga 2) control Pre-post test: T1) baseline T2) 8 weeks T3) 32 weeks	ICD recipients Recruited from clinical and community-based settings in Connecticut 22% women (10/46) 83% White (38/46) 59% had ≥ some college (27/46) 78% annual income ≥ $50k (36/46) 50% were married (23/46)	46 completed 55 enrolled 216 screened	m = 66 ± 13 range n/r	Yoga type: n/r Duration: 8 weeks Frequency: 1 session/week Length: 80 minutes Dose: 11 hours Total: 8 sessions Inclusion criteria: Adults (≥ 18 years of age) Received ICD ≥ 6 wks prior No post-op complications No yoga contraindications Cognitively intact Physician clearance	Ventricular events* Anxiety* Self-compassion* Mindfulness* Medication use Adverse events: n/r Attrition: 16% Attendance: 88% Measures: ECG ICD interrogation FSAS FPAS CES-D PHE STAI IPS SCA SEC EMT	Yoga (n = 26/31) compared to usual care control (n = 20/24) Adapted yoga program to improve cardiovascular and psychosocial outcomes in ICD recipients Guided by protocol to enhance fidelity Postures gradually progressed and were adapted to meet individual needs Individual home practice encouraged &

	54% were unemployed (25/46) 91% did not use tobacco (42/46) 57% moderate ETOH (26/46)		documented (3 days per week x 30 min) CD provided to support home practice Yoga intervention session components: Postures Breathing Relaxation Meditation Selected physical postures used movements consistent with ADL Group sessions Participants per group not described

Vogler 2011	RCT 2-arm intervention: 1) yoga 2) control Pre-post test: T1) baseline T2) 8 weeks	Physically inactive older adults Recruited from a retirement community in Australia 84% women (32/38)	38 completed 40 enrolled	m = 73 ± 8 range 56 – 94	Yoga type: Iyengar Duration: 8 weeks Frequency: 2 sessions/week Length: 90 minutes/session Dose: 24 hours Total: 16 sessions	Pulmonary function Blood pressure Strength* Flexibility* Well-being* Immune function Attrition: 5% Attendance: 88% Measures: Manual muscle testing Back scratch test Goniometry Salivary isoenzymes SF-12 Life's Odyssey Questionnaire	Yoga (n = 19/20) compared to wait list control (n = 19/20) Yoga to promote health and well-being in physically inactive older adults Intervention delivered by trained, certified Iyengar yoga instructor Postures gradually progressed and were adapted to meet individual needs

						Props were provided including belts, blocks, blankets, bolsters, and chairs Regular home practice encouraged (3 days per week x 15 to 20 minutes) Yoga postures described Yoga intervention session components: 25 postures (standing, seated, supine) Group sessions

	≤ 10 participants per group

Note. ADDQoL = Audit of Diabetes-Dependent Quality of Life; ADL = activities of daily living; BI = Barthel Index; BMI = body mass index; CES-D = Center for Epidemiological Studies Depression Scale; BMI = body mass index; Ca^{+} = cancer; CD = compact disc; COPD = chronic obstructive pulmonary disease; CRQ = Chronic Respiratory Disease Questionnaire; CSDD = Cornell Scale for Depression in Dementia; CVA = cerebrovascular accident; DM = diabetes mellitus; DVD = digital versatile disc; D_x = diagnosis; ECG = electrocardiogram; EMT = Expression Manipulation Test; FACT-G = Functional Assessment of Cancer Therapy – General; FPAS = Florida Patient Acceptance Survey; FSAS = Florida Shock Anxiety Scale; HD = heart disease; HS = high school; ICD = implantable cardioverter defibrillator; IPS = Interpersonal Support Evaluation; MI = myocardial infarction; MMSE = Mini Mental Status Exam; mos. = months; MYMOP = Measure Yourself Medical Outcome Profile; NHW = non-Hispanic White; n/r = none reported; PHE = Positive Health Expectation Scale; QoL = quality of life; RCT = randomized controlled trial; SCS = Self-Compassion Scale; SEC = Symptom/Emotion Checklist; SF-12 = 12-item Short Form Health Survey; SF-36 = 36-item Short Form Health Survey; S-FPI = Functional Performance Inventory, short form; SPMSQ = Short Portable Mental Status Questionnaire; SpO_2 = oxygen saturation; SSAI = Spielberger State Anxiety Inventory; STPI = State-Trait Personality Inventory; T_x = treatment; UK = United Kingdom; 6MWT = 6-minute walk test; * = significant result

Study design. Four of the nine studies reviewed were pilot, feasibility, or exploratory RCTs designed to evaluate safety, feasibility, and preliminary intervention effects (Donesky-Cuenco, Nguyen, Paul, & Carrieri-Kohlman, 2009; Littman et al., 2012; Skoro-Kondza, Tai, Gadelrab, Drincevic, & Greenhalgh, 2009; Toise et al., 2013). Seven studies were 2-arm intervention trials comparing yoga to usual care (Donesky-Cuenco et al., 2009; Fan & Chen, 2011; Toise et al., 2013) and wait list control conditions (Chen et al., 2010; Littman et al., 2012; Skoro-Kondza et al., 2009; Vogler, O'Hara, Gregg, & Burnell, 2011). Two studies were 3-arm intervention trials comparing yoga to other types of physical activity (e.g., group walking) and wait list control conditions (Chen et al., 2008; Gordon et al., 2008).

Participant characteristics. The studies reviewed included a total of 830 participants. Sample size ranged from 40 to 231 participants with a mean sample size of 92. The overall sample was comprised of 556 women (74%) and 200 men (26%). Sample mean age ranged from 60 to 75 years, with an overall mean age of 68. While many studies described diversity in their samples, the race and ethnicity of minority participants were often reported as "other" or were simply not reported (Chen et al., 2008; Donesky-Cuenco et al., 2009; Fan & Chen, 2011; Gordon et al., 2008; Littman et al., 2012; Skoro-Kondza et al., 2009; Vogler et al., 2011).

The studies reviewed included healthy older adults and those with chronic health conditions, such as obesity (Littman et al., 2012), diabetes (Gordon et al., 2008; Skoro-Kondza et al., 2009), frailty (Chen et al., 2010), dementia (Fan & Chen, 2011), cancer (Littman et al., 2012), cardiac arrhythmia (Toise et al., 2013), and chronic obstructive pulmonary disease (COPD, Donesky-Cuenco et al., 2009).

Intervention characteristics. Each of the studies reviewed was guided by *Hatha* yoga tradition. *Hatha* yoga integrates physical postures, breathing techniques, and meditation or relaxation. Two studies incorporated *Iyengar* yoga, a type of *Hatha* yoga with an emphasis on safe alignment and the use of props to modify postures and make them more accessible to different body types (Donesky-Cuenco et al., 2009; Vogler et al., 2011). Three studies used Silver yoga, a program designed for older adults to accommodate physical changes commonly associated with aging (Chen et al., 2008, 2010; Fan & Chen, 2011). One study reported the use of Viniyoga™, a type of *Hatha* yoga with a therapeutic focus and attention to individual needs (Littman et al., 2012).

Delivery setting. Each yoga program was delivered in a small group format by certified yoga instructors across a range of community, organizational, and institutional settings, including recreation centers (Chen et al., Skoro-Kondza et al., 2009), retirement communities (Vogler et al., 2011), outpatient clinics (Donesky-Cuenco et al., 2009; Gordon et al., 2008), assisted living facilities (Chen et al., 2010), and long-term care settings (Fan & Chen, 2011). Six of the nine studies encouraged individual home practice in addition to group yoga sessions (Donesky-Cuenco et al., 2009; Gordon et al., 2008; Littman et al., 2012; Skoro-Kondza et al., 2009; Toise et al., 2013; Vogler et al., 2011).

Theoretical perspective. Despite the strengths of a theory-based approach to interventions aimed at changing health behavior, none of the studies reported the use of a theoretical framework to guide intervention design, implementation, or evaluation.

Educational components. Each of the nine studies reviewed incorporated yoga instruction and some included additional health education components. Illustrated workbooks, home

practice manuals, audio recordings, and instructional videos were provided to support individual home practice across five studies (Donesky-Cuenco et al., 2009; Gordon et al., 2008; Littman et al., 2012; Skoro-Kondza et al., 2009; Toise et al., 2013; Vogler et al., 2011). Skoro-Kondza et al. (2009) provided intervention and control group participants with leaflets about diabetes and physical activity. Toise and colleagues (2013) provided monthly telephone calls, encouraging participants to ask questions and seek information regarding their individual health concerns.

Cognitive and behavioral strategies. Cognitive and behavioral strategies are essential components of interventions targeting the initiation and maintenance of health behavior change (Artinian et al., 2010). Cognitive and behavioral strategies are focused on enhancing individual attitudes and beliefs that influence motivation for health behavior change. The AHA recommends using a range of cognitive and behavioral strategies to promote physical activity, including goal-setting, self-monitoring, and motivational interviewing (Artinian et al., 2010).

Gordon and colleagues (2008) encouraged participants in yoga intervention and aerobic physical activity comparison groups to monitor their levels of perceived exertion using a modified Borg scale. Participants were instructed to engage in yoga and physical activity at a moderate level of intensity, assessed using the perceived exertion scale in addition to heart rate monitoring. Participants were instructed to monitor their heart rates before, during, and after yoga sessions, and they were encouraged to aim for a target heart rate estimated at 70% of maximum based on age and resting heart rate (Gordon et al., 2008).

Littman et al. (2012) used motivational interviewing to promote yoga class attendance and encourage participation in home practice. Motivational interviewing techniques included setting goals, identifying barriers, and creating a plan to overcome barriers. Four studies

reviewed provided physical activity logs to participants as a behavioral monitoring strategy and a measure of fidelity to home practice (Donesky-Cuenco et al., 2009; Gordon et al., 2008; Littman et al., 2012; Toise et al., 2013).

Intervention dose. The dose of a physical activity intervention is a product of program duration, session frequency, and session length. Across the nine studies reviewed, intervention dose ranged from 11 hours (Toise et al., 2011) to 96 hours (Littman et al., 2012). Yoga program duration lasted from 8 weeks (Toise et al., 2013; Vogler et al., 2013) to 26 weeks (Littman et al., 2012). Three yoga programs were 12 weeks in duration (Donesky-Cuenco et al., 2009; Fan & Chen, 2011; Skoro-Kondza et al., 2009) and 3 programs were 24 weeks in duration (Chen et al., 2008, 2010; Gordon et al., 2008). Two yoga programs met on a weekly basis (Gordon et al., Toise et al., 2013); three met twice per week (Donesky-Cuenco et al., 2009; Skoro-Kondza et al., 2009; Vogler et al., 2011); and three programs met three times per week (Chen et al., 2008, 2010; Fan & Chen, 2011). The length of yoga sessions ranged from 55 minutes (Chen et al., 2008; Fan & Chen, 2011) to 120 minutes (Gordon et al., 2008) with a mean length of 75 minutes.

Interventionist characteristics. Across the nine studies reviewed, interventionists were experienced yoga instructors certified by established schools of *Hatha* yoga, including *Iyengar*, Viniyoga™, and Silver yoga. To enhance adoption and maintenance of the Silver yoga program, training was provided to staff members and volunteers at the senior centers and assisted living facilities where the program was implemented (Chen et al., 2008, 2010; Fan & Chen, 2011).

Outcome evaluation. Outcomes were assessed immediately following implementation of the intervention (i.e., following the delivery of all program sessions) across each of the nine studies reviewed. Two studies collected data at the end of each yoga session to assess

physiological outcomes (e.g., oxygen saturation and glucose levels) in participants with COPD and type 2 diabetes (Donesky-Cuenco et al., 2009; Skoro-Kondza et al., 2009). Three studies conducted long-term follow-up, collecting data at six months post-intervention (Littman et al., Skoro-Kondza et al., Toise et al., 2013).

Blood pressure. Of the five studies that measured BP, two found that yoga significantly lowered systolic blood pressure (SBP) in community-dwelling older adults ($p < .05$; Chen et al, 2008) and older adults with dementia (Fan & Chen, 2011). Chen et al. (2008) compared 24 weeks of yoga with a wait list control condition in a sample of community-dwelling older adults. Participants randomized to 70-minute yoga sessions, three sessions per week, achieved significant improvement in SBP compared with control group participants ($p < .05$). Similarly, Fan and Chen (2011) compared 12 weeks of yoga with usual care in a sample of older adults with dementia living in long-term care facilities. Participants randomized to 55-minute yoga sessions, three sessions per week, realized significant improvement in SBP compared to those who received usual care ($p < .05$). Three studies did not find significant improvement in BP following 8 weeks of yoga, 2 sessions per week, 90 minutes per session, in community-dwelling older adults (Vogler et al., 2011); 12 weeks of yoga, 2 sessions per week, 90 minutes per session, in adults with type 2 diabetes (Skoro-Kondza et al., 2009); or 24 weeks of yoga, 3 sessions per week, 70 minutes per session, in frail, transitional older adults (Chen et al., 2010).

Body composition. Of the five studies that targeted body composition, two noted significant improvement in BMI and/or percentage body fat ($p < .05$; Chen et al., 2008, 2010). Chen et al. (2008) found that community-dwelling older adults who participated in 12 weeks of yoga, 3 sessions per week, 55 minutes per session, achieved significant improvement in BMI, but

not percentage body fat, compared with a wait list control group ($p < .05$). Conversely, Chen and colleagues (2010) found that frail, transitional older adults who participated in 24 weeks of yoga, 3 sessions per week, 70 minutes per session, realized significant improvement in percentage body fat, but not BMI, compared with a wait list control group ($p < .05$). Fan and Chen (2011) did not find significant improvement in BMI or percentage body fat among older adults with dementia who participated in 12 weeks of yoga, 3 sessions per week, 55 minutes per session, compared with participants who received usual care. Littman et al. (2012) found no significant improvement in BMI or waist and hip circumference among overweight and obese breast cancer survivors who participated in 26 weeks of yoga, 1 to 3 sessions per week, 75 minutes per session, compared with a wait list control group. Skoro-Kondza and colleagues (2009) did not find significant improvement in waist-hip ratio (WHR) among participants with type 2 diabetes who participated in 12 weeks of yoga, 2 sessions per week, 90 minutes per session, compared with a wait list control group, although attendance was low (i.e., 50%).

Glucose and lipids. Two studies targeted blood glucose levels and lipid profiles in community-dwelling adults with type 2 diabetes (Gordon et al., 2008; Skoro-Kondza et al., 2008). Gordon et al. (2008) found significant improvement in fasting blood glucose levels and lipid profiles among participants who completed 12 weeks of yoga or group walking sessions, 1 session per week, 120 minutes per session, compared with a wait list control group ($p < .05$). Skoro-Kondza and colleagues (2009) did not find significant changes in lipid profiles or glycosylated hemoglobin (HbA1c) among adults with type 2 diabetes who participated in 12 weeks of yoga, twice per week, 90 minutes per session, attributing their findings to low rates of attendance.

Self-efficacy. Self-efficacy, an individual's confidence in their ability to engage in a specific behavior despite obstacles or challenges, has been shown to strongly predict physical activity (Bandura, 1977, 2001). Skoro-Kondza et al. (2009) measured self-efficacy using a self-efficacy scale for diabetes, but found no significant improvement in self-efficacy among adults with type 2 diabetes following 12 weeks of yoga, 90 minutes per session, twice per week, compared with a wait list control group.

Physical activity. Four studies used physical activity logs to monitor adherence to individual home practice, although physical activity behavior was not reported as an outcome of these interventions (Donesky-Cuenco et al., 2009; Gordon et al., 2008; Littman et al., 2012; Toise et al., 2013). Littman and colleagues (2012) were the only researchers to assess physical activity beyond yoga practice, using the Modified Activity Questionnaire. No significant improvement was found in physical activity behavior among overweight and obese breast cancer survivors following 26 weeks of yoga, 3 sessions per week, 75 minutes per session, compared to wait list control participants (Littman et al., 2012).

Functional fitness. Each of the nine studies in this review addressed physical fitness and/or function, measuring a range of variables including strength, endurance, flexibility, and balance. Several studies reported significant improvement in strength (Fan & Chen, 2011; Vogler et al., 2011), endurance (Chen et al., 2008; Fan & Chen, 2011), flexibility (Chen et al., 2008, 2010; Fan & Chen, 2011; Vogler et al., 2011), balance (Fan & Chen, 2011), mobility (Chen et al., 2008, 2010; Donesky-Cuenco et al., 2009; Fan & Chen, 2011), and function (Donesky-Cuenco et al., 2009; Fan & Chen, 2011; all $p < .05$). Measures of mobility and

functional fitness included the chair-stand, arm-curl, back-scratch, sit-and-reach, one-leg stand, 2-minute step, and 6-meter walk tests.

Quality of Life. Health-related quality of life is a cardiovascular health metric that encompasses physical, psychological, and social well-being (Lloyd-Jones et al., 2010). Across four studies that assessed quality of life, one reported significant improvement in community-dwelling older adults who participated in 8 weeks of yoga, 90 minutes per session, twice per week (Vogler et al., 2011). Vogler and colleagues (2011) designed a progressively challenging yoga program for sedentary older adults, using props to modify postures and accommodate individual needs. Participants randomized to the yoga intervention group reported significant improvement in quality of life, including domains of physical well-being, mental well-being, and self-care, compared to participants randomized to usual care ($p < .05$; Vogler et al., 2011).

Psychological health. Of three studies reviewed that targeted psychological health outcomes, two noted significant improvements in anxiety, depression, and/or mood ($p < .05$; Fan & Chen, 2011; Toise et al., 2013). Fan and Chen (2011) found that older adults with dementia reported significantly decreased symptoms of depression following 12 weeks of yoga, 55 minutes per session, twice per week, compared with usual care ($p < .05$). Toise and colleagues (2013) found that ICD recipients who participated in 8 weeks of yoga, 80 minutes per session, once per week, achieved significant improvements in anxiety, mindfulness, and self-compassion, as well as decreased arrhythmia episodes and defibrillator events, compared with a control condition ($p < .05$).

Effect size. Of the nine studies reviewed, only one reported effect sizes (Donesky-Cuenco et al., 2009). Among the remaining studies, standardized mean differences were

examined based on available published results; effect sizes were calculated from baseline to post-intervention using standardized formulas with Cohen's *d*. Effect sizes were categorized as small ($d \geq .2$), moderate ($d \geq .5$), and large ($d \geq .8$; Cohen, 1988). Three studies found moderate effects for SBP and BMI (Chen et al., 2008, 2010; Fan & Chen, 2011). Gordon et al. (2008) found large effects for glucose levels and lipid profiles. Several studies found moderate effect sizes for physical fitness outcome variables, including strength, endurance, flexibility, and balance (Chen et al., 2008, 2010; Donesky-Cuenco et al., 2009; Fan & Chen, 2011).

Fidelity. Intervention fidelity reflects the extent to which an intervention is delivered as planned. The NIH Behavior Change Consortium recommends the use of methodological strategies to enhance and monitor fidelity as a best practice in the conduct of intervention research (Bellg et al., 2004). Approaches to enhance and monitor intervention fidelity include the use of a standardized protocol, intervention manuals, audiovisual materials, training of yoga instructors to the intervention protocol, and direct observation of yoga sessions.

A majority of studies used a standardized protocol to guide intervention delivery (Chen et al., 2008; Donesky, Melendez, Nguyen, & Carrieri-Kohlman, 2012; Fan & Chen, 2011; Gordon et al., 2008; Littman et al., 2012; Toise et al., 2013). Most studies provided a description of the intervention, including specific yoga postures (Gordon et al., 2008; Littman et al., 2012; Vogler et al., 2011) and the recommended sequence of practice (Chen et al., 2008, 2010; Donesky-Cuenco et al., 2009; Fan & Chen, 2011). Silver yoga sessions were guided by audiotape to enhance fidelity to intervention delivery. Chen et al. (2008, 2010) recruited two interventionists to deliver each yoga session; one demonstrated physical postures, while the other promoted

safety by offering assistance to participants and encouraging them to engage in yoga practice at a gentle to moderate level of intensity.

Gordon et al. (2008) provided participants with a checklist to determine if specific yoga postures were practiced independently at home. Other researchers used physical activity logs to monitor adherence to home practice (Donesky-Cuenco et al., 2009; Littman et al., 2012; Toise et al., 2013). Four studies provided participants with audiovisual materials in an effort to enhance fidelity to the home practice components of yoga interventions (Donesky-Cuenco et al., 2009; Littman et al., 2012; Skoro-Kondza et al., 2009; Toise et al., 2013).

Many of the studies reviewed were guided by an established yoga tradition, such as *Iyengar* yoga (Donesky-Cuenco et al., 2009; Vogler et al., 2011) or Viniyoga™ (Littman et al., 2012). The use of certified yoga instructors who teach according to the philosophies and practices of these traditions may have enhanced treatment fidelity. However, the methods used to train yoga instructors on the intervention protocol or evaluate treatment delivery were not described in detail. None of the studies reported using an intervention checklist, direct observation, or audiovisual recordings to assess fidelity in the delivery of group yoga sessions.

Risk of Bias. The extent to which a review can draw valid conclusions about the effect of an intervention depends on whether the data and results from the studies reviewed are free from bias (Higgins & Green, 2011). The Cochrane Collaboration's risk of bias tool was used to assess risk of bias in the following domains: (a) selection bias, (b) performance bias, (c) detection bias, (d) attrition bias, and (f) other bias (Higgins & Green, 2011).

Two studies clearly stated the methods used for participant randomization and allocation concealment (Skoro-Kondza et al., 2009, Toise et al., 2013). However, the methods used for

randomization and allocation concealment were unclear in seven of the nine studies reviewed, which may have contributed to selection bias. Of three studies that used cluster randomization, two noted significant differences in baseline characteristics, including marital status and tobacco use, which may have contributed to selection bias (Chen et al., 2010; Fan & Chen, 2011).

Due to the nature of physical activity interventions, participants were not blinded to group assignment. The procedures used to blind data collectors were unclear in seven of the nine studies reviewed. Gordon et al. (2008) used coded questionnaires to assess intervention outcomes, and physical activity logs were reviewed by personnel who were blinded to study conditions. Littman and colleagues (2008) did not blind data collectors to group assignment, which may have contributed to detection bias.

Each of the nine studies reviewed reported differential attrition and provided reasons for loss to follow-up, minimizing the risk of attrition bias. Intervention outcomes were assessed and reported across each of the studies included in this review, minimizing the risk of reporting bias. Four studies conducted intention-to-treat analyses (Donesky-Cuenco et al., 2009; Littman et al., 2012; Skoro-Kondza et al., 2009; Toise et al., 2013), indicating that all participants who were randomized were included in data analyses, minimizing the risk of attrition bias, reporting bias, and other types of bias (Armijo-Olivo, Warren, & Magee, 2009; Gupta, 2011).

Discussion. Cardiovascular disease is the leading cause of death among older adults (Benjamin et al., 2017). Regular physical activity reduces the risk of CVD and related chronic health conditions, including hypertension, obesity, diabetes, and dyslipidemia; however, few older adults engage in adequate levels of physical activity to maintain or improve health (Ward et al., 2016). Low levels of physical activity increase CVD risk and contribute to health

disparities among older adults (August & Sorkin, 2010). Given the anticipated shift in population aging, the development of innovative approaches to cardiovascular risk reduction among older adults is essential to promote public health and reduce health care costs. Recommendations for physical activity research with older adults include identifying practical and relevant interventions that can be built upon to advance science and readied for application to practice.

Intervention outcomes. Yoga offers a unique mind-body approach to promoting physical activity behavior and improving cardiovascular health outcomes among older adults. Findings from the studies reviewed indicate that yoga may promote cardiovascular health by improving BP, body composition, glucose levels, and lipid profiles in healthy older adults and those with chronic health conditions. Yoga practice significantly improved several domains of functional fitness, including strength, endurance, flexibility, balance, and mobility, which are factors that encourage safe participation in physical activity and promote functional independence. Yoga significantly improved psychological health outcomes, including anxiety, depression, mood, and quality of life, factors that contribute to cardiovascular and overall health in older adults.

Effect sizes. Of the nine studies reviewed, only one reported effect sizes (Donesky-Cuenco et al., 2009). Limited reporting of effect sizes in the literature makes it difficult to determine the impact of an intervention on study outcomes and compare outcomes across studies (Mays & Melnyk, 2009). Additional research is needed to evaluate the magnitude of yoga intervention effects on cardiovascular health outcomes, particularly when compared with other interventions.

Social and contextual factors. The studies included in this review were implemented across a range of clinical and community-based settings, including recreation centers, retirement communities, and assisted living facilities. However, there was limited attention to social and contextual factors in the studies reviewed. Few studies reported demographic data related to socioeconomic status; none of the studies reported the racial or ethnic minority status of participants. This reflects a gap in the literature, as members of racial and ethnic minority groups have been underrepresented in cardiovascular health research (CDC, 2012). Minority older adults experience higher levels of cardiovascular risk compared with non-minority older adults; inequities in physical activity by age, gender, race, ethnicity, and socioeconomic status contribute to health disparities (USDHHS, 2014a). There is a need to know whether interventions have differential effects upon participants with different characteristics of vulnerability. This will increase our understanding of the processes through which the intervention works with some participants and not with others. Identifying the responsiveness of different groups to same or different interventions can yield important information about the benefits of specific interventions for at-risk individuals (Fleury & Sidani, 2012).

Theoretical perspective. Theory presents a systematic way of understanding the process of health behavior change, including the initiation and maintenance of physical activity. Physical activity interventions designed with an explicit theoretical foundation are more effective than those lacking a theoretical base (USDHHS, 2014b). Theory provides an understanding of the problem, the nature of the intervention to address the problem, and the mechanism underlying the anticipated improvement in outcomes (Fleury & Sidani, 2012). Thus, theory guides the development of interventions that are more likely to permit strong causal inferences

and interpretable results (Rothman, 2009). Despite the advantages of a theory-based approach to intervention, the explication of theory in the development and evaluation of yoga interventions is limited. While some studies operationalized concepts derived from psychosocial and behavioral theory, few tested theories of health behavior change. Skoro-Kondza et al. (2009) measured self-efficacy, a key construct of Social Cognitive Theory, but did not report using theory to frame the study design or select critical inputs of the intervention. Self-efficacy, an individual's confidence in their ability to engage in a specific behavior such as physical activity, is strongly supported in the research literature as an important component of interventions aimed at changing health behavior in older adults (Bandura, 2001; White, Wójcicki, & McAuley, 2012; Young, Plotnikoff, Collins, Callister, & Morgan, 2014).

Cognitive and behavioral strategies. While several interventions included cognitive and behavioral approaches such as education, goal setting, and self-monitoring (Donesky-Cuenco et al., 2009; Gordon et al., 2008; Littman et al., 2012; Skoro-Kondza et al., 2009; Toise et al., 2013; Vogler et al., 2011), the links between the problem addressed by the intervention, the theory of the intervention, and intervention critical inputs were not well-described, limiting predictions from theory and intervention development targeting specific constructs. Similarly, few studies examined the effects of the intervention on mediating variables. The need for attention to and specification of theoretical mediators in intervention research has been noted (Baranowski, Cerin, & Baranowski, 2009). Without specification of mediating processes, the theoretical mechanisms leading to intervention effects cannot be adequately validated. Knowledge of how and why yoga-based physical activity interventions might be expected to promote cardiovascular health is necessary for application in practice.

Critical inputs. Intervention science cannot be advanced without clear identification of the specific actions of an intervention and the conditions under which the intervention is delivered (Whittemore & Grey, 2002). This level of specificity enables understanding of what constitutes treatment and what does not, thus clarifying the critical inputs of an intervention and potential for variations in treatment delivery, minimizing the possibility of alternative hypotheses, and strengthening internal validity (Fleury & Sidani, 2012). Many of the studies included in this review used multiple approaches to effect change in outcome variables. While a majority of yoga studies integrated physical postures (*asana*), breathing exercises (*pranayama*), and meditation or relaxation (*dhyana*), few details were provided regarding the specific yoga postures selected or the sequence in which they were practiced. As types of yoga vary in the emphasis placed on physical, mental, and spiritual aspects; the physical intensity of yoga postures; the length of time postures are held; the methods used to modify postures; and the sequence of selected postures, attention is needed to reporting the type of yoga taught and the essential components of yoga interventions, including the physical, mental, and spiritual dimensions as well as postures, sequences, and potential modifications (Sherman, 2012). Detailed description of these critical inputs is essential, as knowledge generated from intervention research is used to refine theory, advance science, and build the evidence base for clinical practice (Conn & Groves, 2011).

Intervention dose. The dose of an intervention represents the amount, frequency, and duration with which the treatment is given to produce changes in mediating and outcome variables. Response to treatment is often categorized as a dose-response relationship. Across the studies reviewed, intervention dose varied considerably. As treatment dose was not quantified

by group session attendance or adherence to individual home practice, it is not known whether participants received the full dose of the intended treatment. Quantifying intervention dose allows for a dose-response analysis in the evaluation of intervention effects, which assists in identifying or confirming the optimal dosage for producing relevant outcomes (Fleury & Sidani, 2012). Due to variability in treatment dose and intervention outcomes, future research is needed to determine the specific dose of yoga practice required to promote cardiovascular health among older adults.

Fidelity. Treatment fidelity processes monitor and improve implementation of the intervention so that it is delivered as intended. Among the studies reviewed, the use of an intervention protocol strengthened treatment fidelity. However, there was limited discussion of standardized training of interventionists to performance criteria. Treatment receipt was evaluated through home practice checklists and physical activity logs. Sherman (2012) recommends the direct observation of group sessions to ensure that instructors are delivering the intervention as designed, as well as the use of checklists to specify the components of the intervention that are necessary, sufficient, and optimal to produce expected outcomes.

Risk of bias. Overall, the studies included in this review reflected some risk of bias. In seven of the nine studies, the methods of randomization and allocation concealment were unclear. None of the studies reported blinding to condition, and only two studies described the methods used to blind outcome assessors. Risk of bias related to attrition, selective reporting, and incomplete outcome data was low across studies reviewed.

Objective measures. While the studies reviewed targeted a range of health and fitness outcomes, cardiovascular health variables were not measured consistently across studies, limiting

comparison of intervention approaches. Five of the nine studies assessed BP (Chen et al., 2008, 2010; Fan & Chen, 2011; Skoro-Kondza et al., 2009; Vogler et al., 2011); five studies assessed BMI (Chen et al., 2008, 2010; Fan & Chen, 2011; Littman et al., 2012; Skoro-Kondza et al., 2009); and two assessed blood glucose and lipids (Gordon et al., 2008; Skoro-Kondza et al., 2009). One study measured physical activity behavior as an intervention outcome, assessed with a self-report questionnaire. Future research would be strengthened by measurement of cardiovascular health outcomes that align with AHA 2020 Impact Goals, including BP, BMI, glucose, lipids, and physical activity (Lloyd-Jones et al., 2010). While subjective measures of physical activity have demonstrated acceptable validity and reliability, assessment is strengthened by the addition of objective measures (Strath et al., 2013). The use of objective data collection devices (e.g., accelerometers) is recommended in physical activity research with older adults, as these devices are easy to use, may reduce participant burden, and provide valid, reliable estimates of physical activity data (Strath, Pfeiffer, & Whitt-Glover, 2012).

Follow-up. Across the nine studies reviewed, there was limited follow-up to evaluate the sustainability of intervention effects. Of three studies that evaluated outcomes at six months post-intervention, none addressed behavioral changes in yoga practice or physical activity; one study noted positive outcomes in ventricular arrhythmias and defibrillator events among ICD recipients (Toise et al., 2013). In developing yoga-based physical activity interventions for older adults, additional research is needed to assess long-term changes in cardiovascular health behavior and evaluate the sustainability of effects achieved.

Strengths and limitations. While previous reviews have examined the health benefits of yoga in older adults, this review addresses a gap in the literature as provides a systematic

evaluation of yoga interventions with a focus on reducing cardiovascular risk in older adults. The studies included in this review were aimed at improving a broad range of cardiovascular and overall health variables in healthy older adults and those with chronic health conditions. The intervention components, dose of the intervention, outcomes targeted by the intervention, and procedures used to measure outcomes were variable across studies, limiting our ability to draw firm conclusions about the efficacy of yoga in reducing cardiovascular risk among older adults.

Summary. This review highlights the potential of yoga interventions to promote cardiovascular health in older adults, providing a foundation for strengthening future research in this field. Findings from this review indicate that yoga is effective in promoting several cardiovascular health outcomes. Yoga was shown to improve BP, BMI, glucose, and lipids in both healthy older adults and individuals with chronic conditions. Regular yoga practice improved several other domains of physical fitness and function, including strength, endurance, balance, flexibility, and mobility. Yoga was shown to be safe and feasible among older adults, taking into consideration the unique needs, goals, strengths, and abilities of each individual.

Despite the growing popularity of yoga as a mind-body practice for individuals of all ages and ability levels, few yoga interventions have focused on improving cardiovascular health in older adults. Future research should include exploration of intervention dose and response, consistency in outcome measures, and evaluation of sustainability of effects. Literature in this area needs consistent and objective outcome measures with a focus on the optimal dose of yoga to maximize effectiveness of interventions. Additional research is warranted, as well-designed yoga interventions have the potential to reach older adults with a broad range of health and fitness levels to optimize health and wellness across the lifespan.

Specific Aims

This feasibility study evaluated the acceptability, demand, implementation fidelity, and efficacy of a theory-based yoga intervention to promote physical activity and improve cardiovascular health outcomes in older adults. Wellness Motivation Theory provides a conceptual framework for the intervention, as it has demonstrated efficacy in promoting physical activity among older adults from diverse backgrounds (Fleury, Bomar, Evenson, & Hatch, 2003; McMahon, Wyman, Belyea, Shearer, Hekler, & Fleury, 2015; Perez, 2009). Wellness Motivation Theory acknowledges the interaction of the individual and the social environment in shaping health behavior. Health behavior change is conceptualized as a dynamic, growth-oriented, empowering process mediated by behavior change process variables (i.e., self-knowledge, motivation appraisal, and self-regulation) and social contextual resources (i.e., social support and community resources). The intervention tested in this study is Yoga for HEART (Health Empowerment and Realizing Transformation).

Aim 1. Examine the acceptability, demand, and implementation fidelity of the Yoga for HEART Intervention in community-dwelling older adults.

1a. What is the acceptability of the Yoga for HEART Intervention in older adults, measured by participant evaluation of the intervention protocol (i.e., intervention components, mode of delivery)?

1b. What is the demand of the Yoga for HEART Intervention in older adults, measured by participant attrition rates and attendance in intervention sessions?

1c. What is the implementation fidelity of the Yoga for HEART Intervention, evaluated by the Index of Procedural Consistency and external expert review?

Aim 2. Evaluate the efficacy of the Yoga for HEART Intervention in promoting behavioral change processes, social contextual resources, physical activity health behavior, and cardiovascular health outcomes.

2a. Yoga for HEART participants will demonstrate a significant increase in behavioral change process variables (i.e., self-knowledge, motivation appraisal, self-regulation) and social contextual resources (i.e., social support, community resources) as compared with an Active Control group.

2b. Yoga for HEART participants will demonstrate a significant increase in physical activity health behavior as measured by accelerometer as compared with an Active Control group.

2c. Yoga for HEART participants will demonstrate significant improvement in cardiovascular health outcomes (i.e., BP, BMI, and WHR) and health-related physical fitness (i.e., strength, endurance, balance, and flexibility) as compared with an Active Control group.

Significance of the Research

Older adults engage in lower levels of physical activity and experience higher levels of CVD compared to younger adults. While the benefits of physical activity in maintaining and improving cardiovascular health have been established, strategies to promote physical activity in older adults have not been effective in sustaining long-term health behavior change. Few interventions have addressed the underlying motivational factors that influence physical activity and health behavior change in older adults.

This research provides a theoretical basis for testing an intervention designed to enhance motivation for physical activity and improve cardiovascular health in older adults. Integrating

specific intervention elements designed to encourage the use of individual, social, and environmental resources will facilitate replication in diverse community-based settings.

This research study supports the work of public health and policy organizations, including Healthy People 2020 objectives aimed at increasing physical activity and improving cardiovascular health in older adults (ODPHP, 2017). This research is also consistent with National Institute of Nursing Research (NINR) goals of developing interventions designed to promote health behavior in older adults, an underserved population (NINR, 2016).

Relevance to Nursing Science

Several of the health behavior change models used as a basis for nursing research and practice have been deductively derived from traditional cognitive and behavioral theories borrowed from or shared with other disciplines. Traditional theories and models shared with the fields of psychology, sociology, and education include the Health Belief Model, the Health Promotion Model, Social Cognitive Theory, the Theory of Planned Behavior, and the Transtheoretical Model. While these frameworks have advanced our understanding of physical activity and health behavior change, they may not be as effective in explaining or predicting phenomena of interest to nursing, including the processes through which positive changes in health occur, and the patterning of human health behavior in interaction with the environment (Donaldson & Crowley, 1978; Fleury, 1992). The intervention tested in this research is guided by WMT, a middle-range nursing theory that builds on traditional models of health behavior change (Fleury, 1991, 1996).

Traditional cognitive and behavioral approaches share several limitations in promoting the adoption and maintenance of physical activity among older adults. Worldviews reflected in

traditional theories and models do not place an emphasis on the patterning of human behavior in interaction with the environment, including the factors that influence the initiation and maintenance of behavior over time. Cognitive and behavioral theories emphasize value-expectancy evaluations as guiding health behavior change. From this perspective, behavior is a function of the subjective value of an outcome and the individual expectation that a specific behavior will achieve that outcome (Fleury, 1992). Value-expectancy models provide a theoretical framework to observe and predict behavior, but they do not allow for an examination of the processes through which changes in health behavior occur. Traditional motivational theories assume that the probability of a behavior is a linear function of individual beliefs, implying little change during the processes of intention and action. The factors involved in a behavior, their relative values, and they ways in which they interact remain constant from the time a need is perceived until a behavior is initiated. Conceptualizing motivation as a process has implications for designing interventions to promote long-term behavior change, as the processes that guide the initiation and maintenance of behavior appear to be different, requiring different approaches (Fleury, 1992).

Although deductively derived theories and models identify aspects of cognition and motivation underlying health behavior, they do not examine the meaning of health behavior change to the individual. As the personal meaning of life experiences has been identified as a primary determinant of motivation for health behavior, the development of interventions to promote health behavior change should include an awareness of individual values and goals (Fleury, 1992).

Traditional theories and models assume that motivation for health behavior arises from the perceived susceptibility of an individual or the perceived severity of an injury or disease, implying that motivational processes are triggered by perceived deficits or threats. Deficit-based theories of motivation limit the development of growth-oriented approaches focused on personal values and strengths (Fleury, 1992).

Traditional motivational theories assume health behavior change is a linear event, consistent with the reaction worldview (Fawcett, 1993, 2005). The reaction worldview is a synthesis of the elements of the mechanistic, persistence, totality, and particulate-deterministic worldviews (Fawcett, 1993, 2005). The reaction worldview assumes that human beings are the sum of their bio-psycho-social-spiritual parts, reacting to the environment in a linear, causal manner; change is predictable, occurring in response to survival needs (Fawcett, 1993, 2005). This paradigm is congruent with a positivist philosophy of science, whereby knowledge and truth are derived from that which is observable, measurable, and well-defined (Fawcett, 1993, 2005; Reed, 2006).

In contrast, WMT is congruent with the simultaneous action worldview (Fawcett, 1993, 2005). The simultaneous action worldview combines elements from the organismic, change, simultaneity, and unitary-transformative worldviews. The phenomena of interest are personal knowledge and pattern recognition (Fawcett, 1993, 2005). Unitary human beings are viewed as more than and different from the sum of their parts. The simultaneous action worldview assumes that human beings are in a mutual, rhythmical process of interchange with their environments. Human beings evolve continuously as self-organizing fields, recognized through patterns of

behavior. Change is unidirectional and unpredictable (Fawcett, 1993, 2005). The simultaneous action worldview is consistent with an intermodern philosophy of science (Reed, 2011).

Intermodernism is a philosophical perspective and pluralistic approach to nursing science that encourages diversity in ideas, honoring the wisdom of the "middle way" between dichotomous positivist and post-positivist paradigms (Reed, 2006, 2011). Intermodernism values knowledge generated from a synthesis of theory, research, and practice (Reed, 2006, 2011; Whall & Hicks, 2002). Intermodern knowledge development and critical inquiry are guided by themes of interest to nursing, including human potential, healing environments, and the developmental-contextual nature of health (Reed, 2006).

The ontological and epistemological assumptions underlying WMT are congruent with the simultaneous action worldview and an intermodern philosophy of science. Empowering potential, the overarching construct of WMT, reflects a process of individual growth and development that facilitates the emergence of new and positive health patterns, consistent with individual values and goals (Fleury, 1996).

The Yoga for HEART theory-based intervention uses relational nursing processes focused on values that are meaningful to the individual and consistent with social contextual resources. Relational processes shift from focusing on the determinants of motivation for health behavior to the processes of motivation and the patterning of human health behavior in mutual process with the environment (Arslanian-Engoren, Hicks, Whall, & Algase, 2005). This research advances nursing knowledge by testing an intervention guided by inductively generated nursing theory congruent with contemporary philosophies of science (Reed, 1995, 2006, 2011). It provides a theoretical basis for developing intervention strategies that focus attention on

individual strengths, community support, and environmental resources to enhance motivation for physical activity and promote cardiovascular health in older adults.

Summary

The continued generation of knowledge to increase physical activity is a public health priority, and the development of interventions to promote cardiovascular health is critical to achieving health objectives, reducing healthcare costs, and eliminating health disparities in older adults. This theory-based intervention operationalizes WMT to enhance motivation for physical activity and health behavior change in older adults. As the first step in a program of research, this feasibility study examined the acceptability, demand, implementation, fidelity, and efficacy of a theory-based yoga intervention in sedentary, community-dwelling older adults at risk for CVD.

Chapter 2

THEORETICAL FRAMEWORK

Wellness Motivation Theory (WMT) provided a conceptual framework for the design, implementation, and evaluation of the Yoga for HEART (Health Empowerment and Realizing Transformation) intervention study. Wellness Motivation Theory was selected to guide this research as it is grounded in nursing science and it acknowledges the complexity and contextual dependence of motivation for health behavior change (Fleury, 1991, 1996). This Chapter will begin with an overview of the theoretical perspective guiding the Yoga for HEART Intervention, including underlying assumptions and key constructs. The theoretical approach to the intervention is described, including the theory of the problem, intervention critical inputs, theoretical mechanisms, and expected outcomes (Fleury & Sidani, 2012). Structural factors that may influence Yoga for HEART Intervention delivery and receipt are addressed.

Wellness Motivation Theory

While yoga interventions have demonstrated favorable changes in cardiovascular health among older adults, few have been guided by theories of health behavior change, or explicated theoretical mechanisms underlying intervention effects. Yoga interventions have addressed the problem of physical inactivity and associated health risks, but few have focused on enhancing motivation for physical activity to promote cardiovascular health. Motivation for health behavior change is a complex phenomenon influenced by factors that evolve over time and across situations. Testing a theory-based intervention addressing the problem of decreased motivation for physical activity strengthens the ability to make explicit the nature of behavior change. As motivation is central to the initiation and maintenance of physical activity, it is

essential for researchers and practitioners to develop and implement theory-based interventions that foster motivation for physical activity to improve cardiovascular health outcomes in older adults (Baumeister & Vohs, 2007). The use of theory-based interventions to promote health behavior change provides constructs and tools that bridge existing gaps between theory and practice.

This intervention research is guided by WMT, a middle range nursing theory that focuses on wellness as a way of fostering individual growth in a manner consistent with the achievement of personal goals for health behavior change (Fleury, 1991, 1996). Wellness Motivation Theory provides a conceptual framework for understanding the processes through which motivation for health behavior change is initiated and sustained over time. Wellness motivation is conceptualized as a process of empowering potential for health behavior change consistent with an individual's unique values and goals (Fleury, 1991, 1996).

Underlying Assumptions. The assumptions of WMT move beyond a focus on individual cognition, perception, and intention emphasized in traditional models of motivation for health behavior change (Fleury, 1991, 1996). Behavior is not motivated to relieve tension within an individual's system, but to allow the individual to grow and change according to personal values and goals (Fleury, Thomas, & Ratledge, 1997). Through empowering potential, individuals engage in health behavior based on their self-concept and valued ways of living (Fleury, 1991, 1996).

The key assumptions underlying WMT relate to human beings, wellness, motivation, change, and nursing. Assumptions related to human beings include:

1. Human beings are individuals and members of families, communities, and other groups who have unique values and goals that vary over time and across situations (Fawcett, 2005).
2. Human beings are open and free to choose ways of being that include pursuing wellness (Fleury, 1996; Parse, 1988).
3. Human beings are continually changing in mutual interaction with the changing environment (Rogers, 1988).
4. Human beings are continually developing and growing, becoming more complex and more integrated (Reed, 1997).

Assumptions related to wellness include:

1. Wellness is a purposeful process of individual growth, integration of experience, and meaningful connection with others, reflecting personally valued goals and strengths, resulting in being well and living values (McMahon & Fleury, 2012).
2. Wellness exists across all states of health; it is not a process that can be prescribed.

Assumptions related to motivation include:

1. Motivation is a complex and dynamic process that includes individuals moving beyond the present moment toward goals and dreams (Mitchell, 1988).
2. Behavior is motivated not to address deficits but to foster meaningful growth and change (Fleury, 1991, 1996).

Assumptions related to change include:

1. Health behavior change is a process of intention formation and value-directed activity that guides the creation of healthy goals and patterns of behavior.

2. The decisional processes that guide health behavior change rely on the awareness of personal, social, contextual, and cultural values.

Assumptions related to nursing include:

1. Nurses and healthcare professionals engage with individuals to facilitate the clarification of personal values, meanings, priorities, and resources to make and live valued choices.
2. Nurses and healthcare professionals support individuals in mobilizing or transcending new ways of living and transforming self that integrate and reach beyond old ways (Parse, 1988).

Key Constructs. Empowering potential has been substantiated as a basic psychosocial process that explains individual motivation for health behavior change as a dynamic process of intention formation and goal-directed behavior that facilitates the emergence of new and positive health patterns (Fleury, 1991, 1996). Wellness Motivation Theory specifies the process through which individuals create valued goals, imagine opportunities for action, determine strategies for change, and regulate patterns of behavior. The theory acknowledges the individual interacting in mutual process with the environment through the key constructs of social contextual resources, behavioral change processes, and action (Fleury, 1991, 1996).

Social Contextual Resources. Motivation for health behavior change occurs within social contextual settings and reflects their dynamic interrelationships (Fleury et al., 1997; McMahon, Vankipuram, Hekler, & Fleury, 2014). Social contextual resources are significant in creating individual, social, cultural, community, and environmental conditions that promote health behavior change. Social resources include support from the social network consistent with individual values and expectations. Contextual resources reflect the degree to which social,

cultural, and community resources are identified, created, and used to enact valued goals. Social contextual resources include social and environmental factors that exert a significant influence on behavioral change processes as well as the initiation and maintenance of physical activity health behavior (Fleury et al., 1997; Perez & Fleury, 2009). In the Yoga for HEART intervention, social contextual resources were operationalized by raising awareness and encouraging use of existing individual, social, cultural, community, and environmental resources for physical activity and health behavior change.

Social factors. Social factors include cultural norms and expectations that influence how aging and physical activity are viewed. Among older adults, social support is an especially relevant source of motivation for physical activity, particularly from family, friends, and healthcare providers (Chiang, Seman, Belza, & Tsai, 2008; Costello, Leone, Ellzy, & Miller, 2013; Franke, Tong, Ashe, McKay, & Sims-Gould, 2013). Motivation may be reduced by sociocultural messages that discourage older adults from participating in physical activity (King & King, 2010). For example, some individuals maintain the belief that older adults are meant, or deserve, to rest (World Health Organization [WHO], 2007). Social contextual factors that may limit motivation for physical activity include family and friends who encourage older adults to take it easy (WHO, 2007). Depending on family dynamics, adult children may attempt to overprotect their older adult parents by restricting their participation in physical activity (Kilian, Salmoni, Ward-Griffin, & Kloseck, 2008). In the Yoga for HEART intervention, small group classes were designed to connect individuals with one another, creating a larger and stronger supportive social network for health behavior change. Participants were encouraged to bring a friend or family to each session, building on existing resources for social support.

Environmental factors. Environmental factors influence motivation for health behavior change by determining access to community resources and supportive social networks that provide safe, affordable, and convenient programs and facilities for physical activity (Carlson et al., 2012; Fleury et al., 1997; Mahmood et al., 2012). Environmental factors include connections to community members and social organizations that offer services and opportunities for older adults to engage in physical activity and promote cardiovascular health (Minkler & Wallerstein, 2008). In the Yoga for HEART intervention, participants were encouraged to seek out community resources for yoga and physical activity. The participant workbook included contact information for local resources, including yoga classes and other types of physical activities, specifically designed for older adults. The workbook also included a description of beginner yoga postures and modifications to facilitate home practice. Participants were provided with a yoga mat and props (i.e., blocks and straps) for use at home or in other community-based yoga classes.

Behavioral Change Processes. Behavioral change processes reflect the ways in which individuals create valued goals, imagine opportunities for action, establish personal standards, develop strategies for change, and regulate patterns of behavior. Behavioral change processes reflect the propensity to strive toward new goals and move beyond goals that have been achieved (Perez & Fleury, 2009). Behavioral change processes include self-knowledge, motivation appraisal, and self-regulation.

Self-knowledge. Self-knowledge provides a conceptual foundation for assigning personal meaning to the process of health behavior change (Fleury & Sedikides, 2007). Self-knowledge frames and guides the generation of goals, creation of intentions, and perception of individual

capabilities (Bandura, 1989; Fleury, 1991, 1996; Hooker & Kaus, 1992). It provides a context of meaning through which individuals acknowledge their hopes and fears for the future, facilitating the activation of processes needed to achieve health goals (Fleury & Sedikides, 2007).

The content and function of self-knowledge are essential links between motivation and behavior. Tapping into self-knowledge leads to understanding the motivating factors or reasons for planning and integrating physical activity into daily life patterns. Self-knowledge contains the concepts of self-efficacy and outcome expectations, or cognitive beliefs that determine the construction of behavioral plans to achieve future health outcomes (Bandura, 1977).

Fleury and Sedikides (2007) identified three processes of self-knowledge, including (a) representational processes encompassing desired and feared possible selves; (b) evaluative processes encompassing self-efficacy, goal expectations, and potential for growth; and (c) behavioral action processes encompassing the creation of action plans, negotiation of social context, and self-regulation of behavior. In the Yoga for HEART intervention, self-knowledge was operationalized through the exploration of representational, evaluative, and behavioral action processes.

Motivation appraisal. Motivation appraisal reflects personal readiness to initiate and maintain health behavior change (Yeom, Choi, Belyea, & Fleury, 2011). Motivation appraisal is a process of intention formation and goal-directed behavior consistent with personal beliefs, values, strengths, and resources (Fleury, 1991, 1996). It provides an individually constructed map or model outlining expectations for behavior. Through motivation appraisal, individuals assess their goals, make judgments about the means best suited to achieve these goals, generate plans and strategies, and determine their commitment to valued outcomes (Fleury, 1991, 1996;

Fleury & Cameron-Go, 1997). The creation of and commitment to a plan of action can activate self-relevant information and mobilize resources for goal-directed behavior such as physical activity (Biggs & Fleury, 1994). In the Yoga for HEART intervention, motivation appraisal was operationalized through analyzing concerns about physical activity and health; linking personal beliefs, values, and resources to goals for health behavior change; and developing motivational skills to achieve valued goals.

Self-regulation. Through self-regulation, personal intentions are transformed into behavioral action (Fleury, 1998). Self-regulation reflects the mechanisms through which individuals attempt to make strategies for health behavior change congruent with valued goals, even when goals conflict or change over time. The pursuit and attainment of goals and the maintenance of self-determined standards of behavior are critical sources of motivation that involve self-regulation. Self-regulation includes cognitive, affective, and behavioral strategies that guide individual responses to social and contextual cues such as the family and community environment. In the Yoga for HEART intervention, self-regulation was operationalized through the use of problem-solving strategies; the development of resources to support goal achievement; the use of self-monitoring techniques; the planning of responses to social contextual influences; and the management of barriers to maintaining physical activity behavioral change.

Action. Action is mediated through increased awareness and use of social contextual resources and increased behavioral change processes (McMahon et al., 2014). The action construct in WMT informs which behavioral and health outcomes are relevant to the problem and the population under study. As the overarching goal of the Yoga for HEART intervention is to enhance motivation for physical activity to promote cardiovascular health, study outcomes are

linked to social contextual resources, behavioral change processes, physical activity health behavior, and cardiovascular health outcomes.

Theoretical Basis of the Intervention

Wellness Motivation Theory provided a conceptual basis for the Yoga for HEART intervention. For a theory to meaningfully guide the design, implementation, and evaluation of an intervention, it should address the following elements: (a) the problem under focus; (b) intervention critical inputs; (c) theoretical mechanisms; (d) expected outcomes; and (e) structural factors (Sidani & Braden, 2011). Attention to these elements is essential to understanding why, how, and under what conditions the intervention effects occur. Theoretical components of the Yoga for HEART intervention are presented in Figure 2.

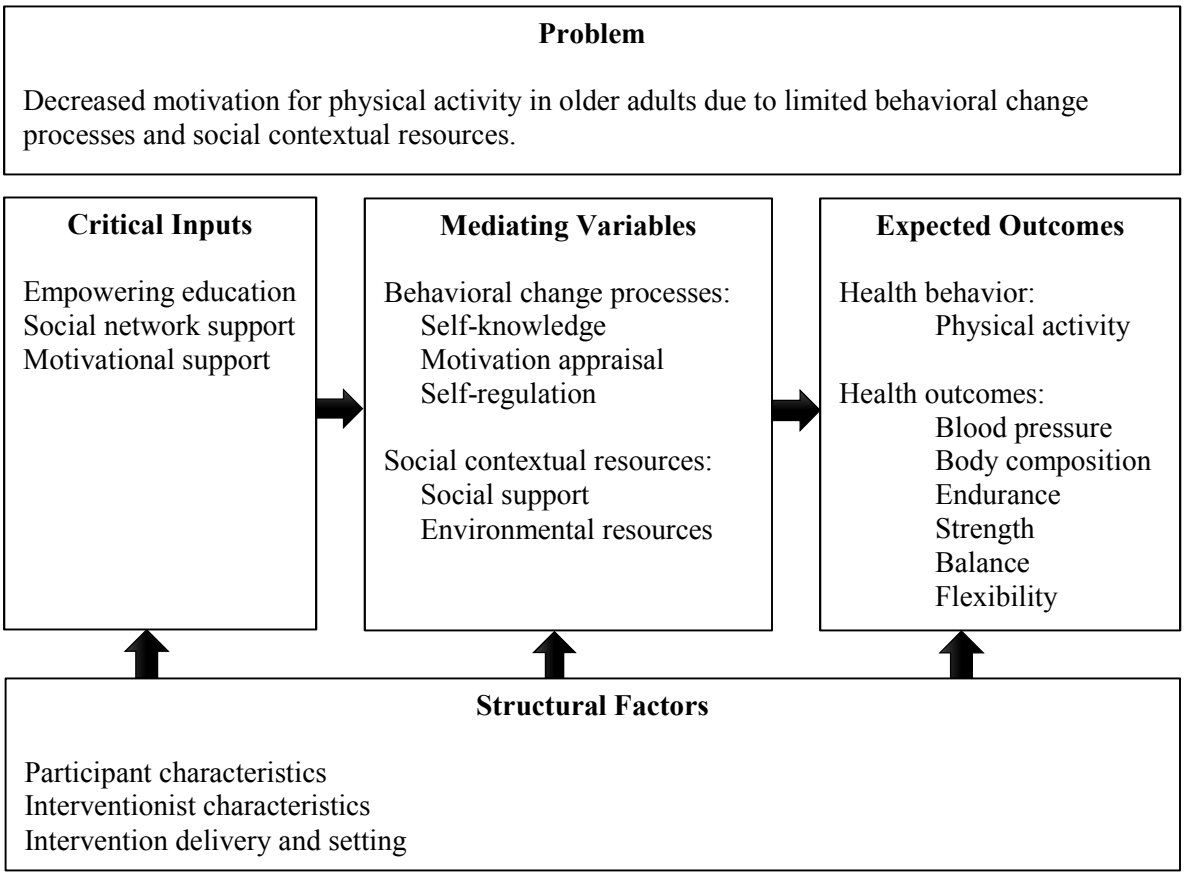

Figure 2. Theoretical components of the Yoga for HEART Intervention.

Problem. Wellness Motivation Theory explains the problem of decreased motivation for physical activity health behavior change as limited social contextual resources and behavioral change processes. Motivation for physical activity to promote cardiovascular health in older adults is fostered by the identification and development of social contextual resources and behavioral change processes, including self-knowledge, motivation appraisal, self-regulation,

social support, and environmental resources. Increasing awareness of and access to individual, social, cultural, community, and environmental resources may lead to favorable changes in physical activity behavior and cardiovascular health outcomes among older adults.

Critical Inputs. Critical inputs are the essential components or active ingredients of an intervention that are responsible for activating mechanisms of behavioral change, linking theoretical mediating processes to health behavior outcomes (Sidani & Braden, 2011). To meet the aims of enhancing motivation for physical activity and promoting cardiovascular health, the Yoga for HEART intervention is designed to operationalize key dimensions of WMT by increasing social contextual resources and behavioral change processes. On the basis of theoretical and empirical testing, the critical inputs of the Yoga for HEART intervention are designed to deliver empowering education, strengthen social networks, and provide motivational support for physical activity and health behavior change in older adults (Fleury, Belyea, & Harrell, 2000; Perez & Fleury, 2009; McMahon, Vankipuram, & Fleury, 2013).

Empowering education. Consistent with the philosophical principles of yoga and WMT, the Yoga for HEART intervention was delivered from a perspective of empowering education. Empowering education fosters the identification and generation of social contextual resources for health behavior change, advocating a participatory approach in which individuals are not passive recipients of knowledge, but the active subjects of their own learning experiences (Friere, 1970; Minkler & Wallerstein, 2008). Individuals are engaged in problem identification and critical thinking to analyze the social context of health concerns. The role of the interventionist is to serve as a resource, facilitating conditions for community members to share in dialogue and to partner in constructing intentions for individual and community change.

Dialogue is the process of soliciting, understanding, and representing community positions (Downey, Anyaegbunam, & Scutchfield, 2009). It establishes meaning in complex situations by encouraging individuals to share their unique perspectives and experiences with one another. Creating opportunities to exchange different perspectives is a critical step in deciding how to address community problems. Common problem definitions are necessary to name health issues, identify acceptable solutions, and guide program implementation. Through the process of dialogue, participants envision opportunities, develop strategies, and build resources to change their lives and communities (Minkler & Wallerstein, 2008).

In the Yoga for HEART intervention, participants engaged in empowering educational activities that fostered the identification and development of personal, social, cultural, community, and environmental strengths and resources. Time and space were provided during intervention sessions for participants to engage in dialogue and critically analyze the social context of culturally relevant health issues. Group discussions included topics about the (a) cardiovascular and overall health benefits of regular physical activity; (b) advantages of progressing gradually and following an individualized plan; and (c) use of strategies to maintain physical activity patterns and integrate behavioral change into daily life.

Social network support. Physical activity takes place in a social context of families, friends, and community settings that influence processes of behavioral change. Social network membership may provide a sense of purpose, promote recognition of self-worth, enhance motivation for self-care, and improve utilization of community resources (Fleury, Keller, & Perez, 2009). Social network support is designed to provide social support and strengthen existing social networks (Yeom & Fleury, 2013). The mobilization of naturally occurring social

networks is essential to sustainability, as these networks are likely to endure following study implementation. Social network support promotes the capacity to identify and create social contextual resources for physical activity and health behavior change. The Yoga for HEART intervention addressed key dimensions of social support, defined as aid or assistance exchanged through interpersonal relationships and interactions.

Motivational support. Motivational support refers to helping individuals establish realistic goals and enact behavioral strategies to accomplish these goals. It focuses on skill development to support the adoption and maintenance of behavioral change through: (a) exploration and verbalization of goals and values; (b) identification and development of personal and community resources; (c) anticipatory problem solving to overcome barriers; and (d) self-monitoring and self-regulation of physical activity.

To provide motivational support, the Yoga for HEART intervention assisted participants in identifying and developing the knowledge, skills, strategies, and resources to overcome personal barriers and challenges to health behavior change. Time and space were provided to facilitate group discussion related to personal goals and accomplishments, barriers and challenges related to physical activity, and problem-solving strategies to sustain motivation for behavioral change. Plans for the future were shared and achievements were celebrated throughout the intervention sessions.

Yoga for HEART intervention. While there are many approaches to yoga practice, each with a different emphasis on the mind, body, and spirit, at its fundamental core, yoga is an ancient wisdom tradition, a philosophical framework for living and being well (Feuerstein, 2011; Iyengar, 2014; Khalsa, Cohen, McCall, & Telles, 2016). The Yoga for HEART intervention was

based on principles of *Astanga* yoga (Satchidananda, 2012). The *Astanga* system of yoga is comprised of eight limbs, including *yama* (ethical restraints), *niyama* (ethical observances), *asana* (physical postures), *pranayama* (breathing exercises), *pratyahara* (sensory withdrawal), *dharana* (concentration), *dhyana* (meditation), and *samadhi* (self-actualization or bliss; Figure 3).

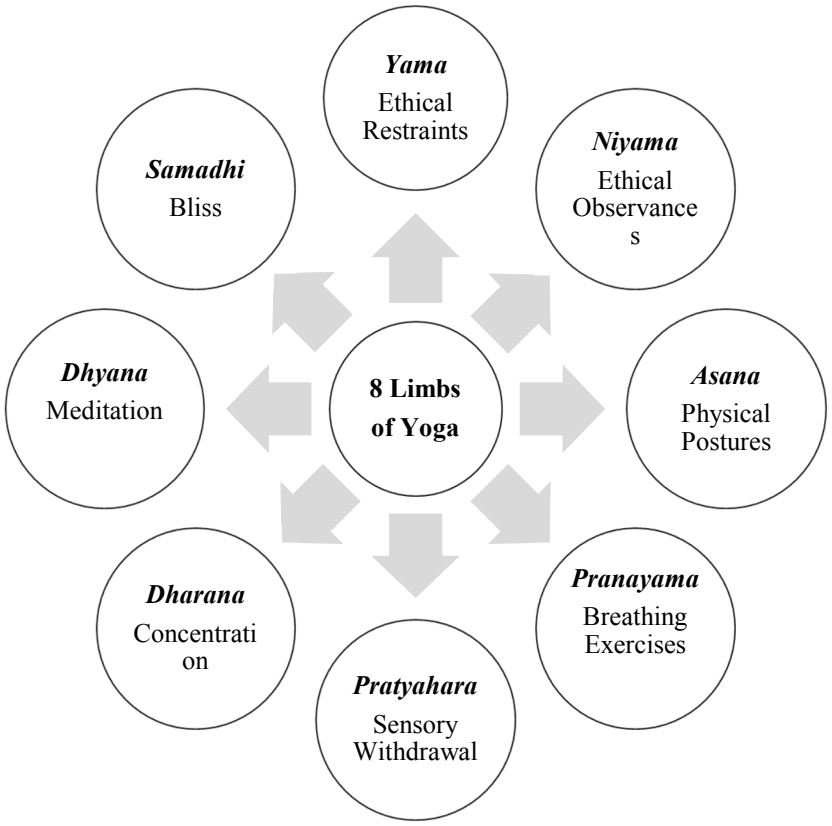

Figure 3. Eight limbs of *Astanga* yoga.

The first two limbs of yoga, *yama* and *niyama*, provide the foundation for all other limbs of yoga. The *yama-s* consist of five ethical restraints, including *ahimsa* (non-harm) and *satya*

(truthfulness), that guide yoga practice and support harmonious relationships with others and the environment. The *niyama-s* are comprised of five ethical observances, including *tapas* (discipline) and *svadhyaya* (self-study) that underlie yoga practice and encourage caring behavior toward the self and others (Bachman, 2011). Each of these ethical principles was woven throughout the Yoga for HEART intervention. For example, each class placed an emphasis on being kind to oneself and others; practicing in a safe manner that does not cause harm; engaging in self-study to identify strengths, abilities, and resources; committing to the process of change with focus, persistence, and discipline; letting go of judgements, expectations, and attachments; and replacing negative, unhealthy patterns with positive, healthy patterns of cognition, emotion, and behavior.

Each Yoga for HEART intervention session began with an opening or centering exercise practiced in a comfortable and relaxed position with attention focused on the breath (Table 2). After a brief introduction to yoga philosophy, participants practiced physical postures (*asana*) in a specific sequence designed to promote endurance, strength, flexibility, and balance (Table 3). Each posture was held for a particular period of time (e.g., 3 to 5 breaths) and practiced in a flowing manner consistent with cardiovascular endurance exercise at a moderate level of intensity (i.e., rated 5 to 6 on a perceived exertion scale of 0 – 10). Cardiovascular endurance exercises are continuous, rhythmic in nature, and involve large muscle groups (Chodzko-Zajko, 2014). The postures included in the Yoga for HEART intervention involved all of the large muscle groups of the body and were practiced in standing, seated, supine, and prone positions.

Table 2
Standard Yoga for HEART Session Format

Program elements	Time (min)
Opening or centering exercise (pranayama/dhyana)	5
Physical postures (asana)	40
Closing exercise with relaxation/meditation (pranayama/dhyana)	5
Group discussion	10
Total	60

Participants were provided with a yoga mat and props, including chairs, blocks, bolsters, blankets, and straps, to modify each physical posture according to individual needs. The difficulty level progressed gradually over time as participants gained knowledge, skills, confidence, fitness, and ability. To honor the principle of *ahimsa*, participants were reminded to practice yoga at their own pace without comparison to others. They were encouraged to find a comfortable and steady place in each yoga posture and to rest when appropriate. Participants were instructed to discontinue yoga and contact their healthcare provider if they experienced dizziness, shortness of breath, chest pain, or any sensation of pain beyond mild discomfort.

Each yoga sequence ended with restorative postures and a closing exercise such as guided meditation and/or breath control. Finally, time was allocated for small group discussion to foster dialogue among participants and facilitate the delivery of theory-based educational components, including motivational strategies such as goal setting, self-monitoring, social support, and problem solving to anticipate and overcome obstacles to health behavior change. The concept of *svadhyaya* (self-study) was applied throughout each intervention session as participants engaged in self-observation and self-refection through activities designed to bring awareness to each individual's goals, values, strengths, resources, and patterns of behavior.

Table 3

Yoga for HEART Intervention Postures

Posture	***Asana***
Mountain pose	*Tadasana*
Mountain w/arms extended	*Urdhva Hastasana*
Mountain w/fingers interlaced	*Baddhanguliasana*
Forward fold	*Uttanasana*
Downward facing dog pose	*Adho Mukha Svanasana*
Warrior II pose	*Virabhadrasana II*
Plank pose	*Ardha Chaturanga Dandasana*
Four-limbed staff pose	*Chaturanga Dandasana*
Tree pose	*Vrksasana*
Staff pose	*Dandasana*
Seated forward fold	*Paschimottanasana*
Simple twisting pose	*Bharadvajasana*
Knees to chest pose	*Apanasana*
Reclining twist pose	*Jathara Parivartanasana*
Final relaxation pose	*Savasana*
Crescent pose	*Anjaneyasana*
Sphynx pose	*Salamba Bhujangasana*
Bent knee pose	*Janu Sirsasana*
Bridge pose	*Setu Bandha Sarvangasana*
Triangle pose	*Trikonasana*
Marichi's pose	*Marichyasana*
Mountain w/cow face arms	*Tadasana Gomukhasana*
Chair pose	*Utkatasana*
Locust pose	*Salabhasana*
Bound angle pose	*Baddhakonasana*
Side angle pose	*Parsvakonasana*

Theoretical mechanisms. Theoretical mechanisms are the intervening variables that are

proposed to mediate behavioral change (Abraham & Michie, 2008). Theory-based interventions should specify how critical inputs are linked to mechanisms of behavioral change and explain the processes through which interventions achieve expected outcomes. A systematic review of yoga interventions to promote cardiovascular health in older adults found a paucity of theory-based yoga intervention research in the published literature (Barrows & Fleury, 2016). The Yoga for HEART intervention is designed to address this gap, as WMT operationalizes and measures relevant theoretical constructs as a basis for testing mechanisms of behavioral change.

The intended effects of the Yoga for HEART intervention were favorable changes in physical activity health behavior and cardiovascular health outcomes. Achievement of intervention outcomes was contingent upon increased awareness and use of social contextual resources, engagement in behavioral change processes, and participation in physical activity relative to baseline values. For significant improvements in health behavior and health outcomes to occur, participants must have experienced favorable changes in self-knowledge, motivation appraisal, self-regulation, social support, and environmental resources. The mechanisms responsible for change were contingent upon participation in the intervention sessions and the fidelity of the intervention, including interventionist delivery and participant receipt (Bellg et al., 2004).

Intervention outcomes. Yoga for HEART was aimed at improving cardiovascular health behavior and health outcomes in older adults. Intervention outcomes include the health behavior of physical activity and the health outcomes of blood pressure, body mass index, and waist-hip ratio. Physical activity health behavior was measured objectively using actigraphy. Cardiovascular and health-related fitness outcomes were measured using a standardized protocol.

Structural factors. Structural factors are elements that influence the implementation, mediators, and outcomes of an intervention, including the characteristics of the participants receiving the intervention, the characteristics of the interventionist delivering the intervention, and the environmental setting or context in which the intervention is provided.

Participant characteristics. Participant characteristics consist of an individual's personal profile, including their health status and past experience with yoga and/or physical activity. Participant characteristics also include their level of social support and available resources. These characteristics may influence the implementation of the intervention, engagement in psychosocial processes of change, enactment of physical activity behavior, and intervention outcomes. The Yoga for HEART intervention used a comprehensive screening and enrollment process to ensure that each individual was healthy enough to participate in moderate intensity physical activity. The Physical Activity Readiness Questionnaire+ (PAR-Q+) was used to screen for health conditions and refer participants to their physician for medical clearance (ACSM, 2014a). The Yoga for HEART intervention was also designed to focus attention on participant characteristics such as social support and community resources, as identifying and building these characteristics are essential to the process of health behavior change.

Interventionist characteristics. As the interventionist is the medium through which the intervention is delivered, the active ingredients of the intervention are provided through interactions between the interventionist and participants. As a result, the personal and professional characteristics of the interventionist play a role in the implementation and effectiveness of the intervention. Personal attributes include demographic characteristics (e.g., age, gender, and ethnicity), communication skills, and demeanor. The demeanor of the

interventionist is important as it contributes to the establishment of trust and rapport, which form the basis of the relationship between the interventionist and participants. Professional characteristics include the educational background, experience, and competence of the interventionist. The Yoga for HEART intervention was delivered by a registered nurse and a certified yoga instructor who has experience working with older adults. The interventionist conveyed a warm, friendly, and nonjudgmental attitude when interacting with participants, and communicated information clearly using verbal and written cues to promote understanding. Holiday greeting cards and personal thank-you notes were mailed to all participants to express gratitude for their participation in the study.

Delivery setting and context. The context of an intervention is the environmental setting in which it takes place. The environmental context should have the necessary features and resources to facilitate the delivery of the intervention and achieve intended outcomes. Yoga sessions took place in a studio with ample space, adequate lighting and ventilation, and a quiet atmosphere to promote relaxation and meditation. Yoga props including mats, straps, blocks, bolsters, blankets, and chairs were provided to each participant. Public transportation and free parking were available at the yoga studio.

Summary. Despite the identification of motivation as an important determinant of physical activity, few interventions to promote physical activity in older adults have focused on motivational factors, including social contextual resources and behavioral change processes; few yoga interventions reported in the published literature are guided by theories of health behavior change. This pilot study contributes to our knowledge base by testing the feasibility of a theory-

based yoga intervention to enhance motivation for physical activity and promote cardiovascular health in sedentary, community-dwelling older adults at risk for cardiovascular disease (CVD).

Chapter 3

RESEARCH DESIGN AND METHODS

There is empirical support for the Wellness Motivation Theory (WMT; Fleury, 1996; McMahon et al., 2015; Perez, 2009) and the health benefits of yoga (Barrows & Fleury, 2016; Chu, Gotink, Yeh, Goldie, & Hunink, 2014), however it remains unknown how these combined approaches enhance motivation for physical activity and improve cardiovascular health outcomes among older adults. Preliminary research is needed to determine if a combined intervention approach is appropriate for full scale testing in the older adult population. This feasibility study examined the extent to which the Yoga for HEART (Health Empowerment and Realizing Transformation) Intervention (a) was acceptable to participants, (b) was used by participants, (c) was implemented with fidelity, and (d) demonstrated potential in efficacy testing (Bowen et al., 2009). This Chapter summarizes the intervention design, including methods used to evaluate acceptability, demand, implementation fidelity, and efficacy in increasing motivation for physical activity and improved cardiovascular health outcomes in older adults. This Chapter builds on Chapter 2 in outlining the critical inputs of the theory-based intervention, and it describes the research design and methods.

Yoga for HEART. The Yoga for HEART Intervention to enhance motivation for physical activity and promote cardiovascular health in older adults was approved by the Arizona State University Institutional Review Board (IRB). The Intervention was designed based on critical content tested in previous theory-based intervention research (Fleury, Belyea, & Harrell, 2000; Perez, 2009; McMahon, 2012), and a systematic review of yoga interventions to improve cardiovascular health in older adults (Barrows & Fleury, 2016). The Yoga for HEART

Intervention was guided by a standardized protocol and individualized according to participant abilities, needs, goals, and preferences.

The critical inputs of the theory-based yoga intervention included: (a) empowering education focused on identifying and developing social contextual resources; (b) social network support promoting the mobilization of naturally occurring social networks; and (c) motivational support to enhance resource identification and to facilitate behavioral change processes. Critical inputs are designed to build individual capacity to initiate and maintain physical activity over time. Participants were encouraged to create and evaluate personal goals for physical activity and to self-monitor their progress. The critical inputs delivered by the Yoga for HEART Intervention are outlined in Table 4.

Active Control. Based on feedback from community dwelling older adults during recruitment, the research team modified the control group from an Attention control condition (e.g., mailed newsletters) to an Active Control condition (e.g., yoga classes). Several participants expressed an interest in yoga, and many expressed a disinterest in receiving newsletters. In response to this feedback, small group yoga classes were offered to Action Control participants, instead of health newsletters. Older adults randomly assigned to the intervention condition received Yoga for HEART, a theory-based intervention designed to increase motivation for physical activity and improve cardiovascular health in older adults. Older adults randomly assigned to the Action Control condition received yoga classes with no theory-based components.

Older adult participants in the Yoga for HEART Intervention attended 60-minute group yoga classes, once per week, for 12 weeks. Participants were guided through a series of physical

postures (*asana*), breathing exercises (*pranayama*), and relaxation or meditation (*dhyana*). Yoga for HEART sessions were based on WMT; each class included critical inputs of empowering education, social network support, and motivational support. These elements were delivered throughout each yoga class and were emphasized during group discussion. Participant workbooks guided discussion and provided each participant with theory-based tools used to facilitate awareness and use of social contextual resources and processes of behavioral change, including fostering self-knowledge, motivation appraisal, and self-regulation.

Older adult participants in the Active Control group attended 60-minute group yoga sessions, once per week, for 12 weeks. Participants practiced postures (*asana*), breathing (*pranayama*), and relaxation/meditation (*dhyana*) using the same yoga protocol as the Yoga for HEART intervention. Participants in the Active Control group did not receive theory-based content, and they did not engage in group discussion or receive a participant workbook.

Research Design

This feasibility study was a randomized controlled trial designed to evaluate the acceptability, demand, implementation, and efficacy of the Yoga for HEART Intervention in enhancing motivation for physical activity and improving cardiovascular health outcomes in older adults. Participants were randomly assigned to one of two groups: (1) Intervention (Yoga for HEART), or (2) Active Control (yoga). Individuals randomized to the Intervention group participated in 60-minute small group yoga sessions based on WMT, once per week, for 12 weeks. Individuals randomized to the Active Control group received 60-minute small group yoga sessions, once per week, for 12 weeks; class content did not include theory-based

approaches. The Intervention dose, including program length, session frequency, and session duration were determined by a review of the literature (Barrows & Fleury, 2016).

Participants were sedentary community-dwelling older adults. Primary outcomes included cardiovascular health behaviors and health factors, including physical activity, blood pressure (BP), body mass index (BMI), and waist-hip ratio (WHR). Health-related physical fitness outcomes included endurance, strength, balance, and flexibility. Theoretical mediating variables included social contextual resources and behavioral change processes. Data collection took place at (T1) baseline and (T2) 12 weeks. This two-group repeated measures study had one between-subjects treatment factor (Intervention versus Action Control group) and two within-subjects time factors (T1 – T2). Eligibility screening was conducted via telephone. Data collection and intervention sessions took place at a community-based yoga studio in Los Angeles. Data was collected on all participants immediately prior to the start of the intervention (T1) and following the last intervention session at 12 weeks (T2). This feasibility study provided an opportunity to estimate effect size, power, and sample size for a larger efficacy study (Bowen et al., 2009).

Research Methods

Sample. Inclusion criteria were as follows: (a) ≥ 50 years of age; (b) sedentary (< 150 minutes of moderate intensity physical activity per week); (c) able to ambulate without an assistive device; (d) cognitively intact; (e) English literate; and (f) able to participate in weekly group yoga sessions.

Ability to participate in physical activity was determined using the Physical Activity Readiness Questionnaire (PAR-Q+) to assess risk in accordance with American College of

Sports Medicine (ACSM) guidelines (ACSM, 2014a). Participants who responded affirmatively to any PAR-Q+ items obtained physician clearance prior to study participation. The Stages of Change Questionnaire was used to assess current level of participation in physical activity (Marcus & Forsythe, 2009). The telephone version of the Mini-Mental State Examination (tMMSE) was used to determine cognitive status (Newkirk et al., 2004). English literacy was assessed through participant self-report.

Eligible participants were able to provide informed consent and attend weekly intervention sessions.

The sample was comprised of 15 older adults, with 8 participants randomly assigned to the intervention group and 7 participants randomized to the Active Control group. This sample size was deemed appropriate for a pilot feasibility study to assess acceptability, demand, implementation, and efficacy (Bowen et al., 2009).

Setting. The research was conducted in Los Angeles, California. Group yoga sessions were delivered during daytime hours at a community yoga studio in a safe, clean, quiet, private space to minimize distractions and interruptions. Public transportation, free parking, and private restrooms were available to participants. Group sessions were limited to 10 participants to provide individualized attention with a focus on safety. Participants were provided with a yoga mat and props, including blocks, blankets, bolsters, straps, and chairs. Props were used to modify yoga postures and adapt the practice to meet individual needs. As limitations in endurance, strength, flexibility, and balance are commonly associated with aging, the use of props promotes safe alignment and enhances the accessibility of yoga postures to older adults.

Recruitment and retention. Recruitment was conducted in partnership with community leaders, senior centers, and healthcare clinics serving older adults in Los Angeles. Informational letters were distributed to promote awareness of the intervention study among local community members and healthcare providers. The study purpose and procedures were presented to older adults and community leaders during meetings designed to address healthy aging issues. Participants were recruited using flyers and presentations held during community events such as games, luncheons, and seminars. Older adults who expressed interest in participating were invited to share their contact information with the interventionist, who coordinated meeting times to conduct eligibility screening, obtain informed consent, and collect baseline data.

Recruitment efforts targeted study participants whose gender, race, ethnicity, and socioeconomic status were representative of the older adult population in Los Angeles County, located in the geographic region of southern California. Los Angeles County has a population of 10,017,068 (U.S. Census Bureau, 2013). The majority of residents are of White/Caucasian or Hispanic/Latino ethnicity, comprising 27.2% and 48.3% of the population, respectively (U.S. Census Bureau, 2013). A total of 1,192,031 individuals aged 65 and older live in Los Angeles County; approximately half (50.7%) are female (U.S. Census Bureau, 2013). A majority (76.4%) of residents aged 25 and older are high school graduates; 29.5% have earned a bachelor's degree or higher (U.S. Census Bureau, 2012). The per capita income is $27,900; 17.1% of residents live below the poverty line (U.S. Census Bureau, 2012). Cities with increased proportions of older adults (≥ age 65 years) include Santa Monica (15%) and Malibu (18.4%) (U.S. Census Bureau, 2010). Participants were recruited from these communities, whose respective populations are 92,472 and 12,861 (U.S. Census Bureau, 2013). Recruitment

strategies included informational flyers and newsletters distributed throughout community settings that serve a diverse range of older adults, including senior centers, shopping plazas, healthcare clinics, and pharmacies.

Approaches to recruitment and retention included personalized contact between participants and the interventionist through mailed invitations and reminder phone calls, placing an emphasis on the potential benefits of research findings to others, and conveying a warm and welcoming atmosphere to participants. The frequency, duration, and length of participation was clearly communicated and reinforced with verbal reminders and meeting calendars to maximize retention. Information about what to anticipate in terms of time commitment, class expectations, and testing procedures was shared with participants prior to each point of data collection. The interventionist contacted participants via phone, text, mail, and/or email to remind them of scheduled data collection times. Participants were compensated with a $20 gift card at each measurement time point. Personalized thank-you cards were mailed to each participant.

Attendance was encouraged throughout both Intervention and Active Control sessions. Attendance rosters were checked twice weekly, and reminder telephone calls were made to participants who missed any intervention sessions. The interventionist met weekly with research mentors to discuss study progress including recruitment, retention, implementation, protocol deviation, adverse events, data collection, data management, and new research information.

Data Collection Procedures

Testing procedures and measurement times were analogous for Intervention and Active Control conditions. Data collection was standardized across T1-T2 and took place at the yoga studio. Data collection was conducted by a research assistant trained in the protocol and blinded

to study condition. The interventionist trained the research assistant in measurement of variables, including the administration of self-report questionnaires and the conduct of physical assessments. Education and training were delivered through a web-based module and a live interactive session, facilitating the acquisition of knowledge and skills as a basis for developing competencies to accurately conduct testing procedures. Specific learning objectives addressed during the research assistant training included: (a) identify the purpose of the research; (b) describe procedures used in measurement sessions, (c) practice effective communication strategies; and (d) demonstrate testing procedures consistent with selected measures and data collection requirements. The research assistant and the interventionist independently obtained study measures on two test volunteers to establish competence and inter-rater reliability.

Screening

Potential participants were screened for eligibility during telephone interviews. A screening form was used to assess each individual's age, health status, cognitive status, current participation in physical activity, and readiness for physical activity (ACSM, 2014a). Individuals eligible to participate were invited to an enrollment appointment that combined informed consent and baseline testing procedures (T1). Individuals who expressed interest in yoga or physical activity but were not eligible for study participation were referred to other community resources.

Cognitive status was screened using a telephone version of the MMSE, the tMMSE (Newkirk et al., 2004). A score of $\geq 21/26$ on the tMMSE, indicating no severe cognitive impairment such as dementia, was required to provide informed consent and participate in the study.

Current participation in physical activity was assessed using the Stages of Change Questionnaire (Marcus & Forsythe, 2009). Individuals who reported engaging in at least 150 minutes of moderate-intensity physical activity per week were excluded from the study.

Screening for safe participation in physical activity was conducted using the PAR-Q+ (ACSM, 2014b). Individuals who responded affirmatively to any PAR-Q+ items were asked to obtain clearance from their primary care provider prior to study enrollment. Healthcare providers received information regarding the study and were encouraged to contact the interventionist with any questions or concerns.

Informed Consent and Enrollment

Interested and eligible participants provided informed consent. The interventionist met with each participant individually to review the risks, benefits, and options of study participation. Each eligible participant was provided a written copy of the consent form for review. Potential participants were encouraged to ask questions and express concerns. For those who provided verbal and written informed consent, baseline measures (T1) were initiated.

Random Assignment

Participants were randomly assigned to the Yoga for HEART Intervention group or the Active Control group immediately after providing informed consent. Individuals who chose to participate in Thursday afternoon sessions received the Yoga for HEART theory-based intervention; participants who chose to attend Monday afternoon sessions received group yoga classes with no theory-based intervention components. A random sequence generator was used to assign each study condition to its corresponding day of the week. Random assignment enhances internal validity by maximizing the chance that participants in the intervention and

control groups have similar characteristics and by minimizing the probability of systematic differences between groups.

Interventionist Training

Yoga for HEART sessions were led by the interventionist, a registered nurse and a certified yoga instructor who had experience teaching yoga to older adults. To develop competencies for intervention delivery, the interventionist acquired specialized knowledge and skills related to older adult learning principles and communication strategies, group facilitation, assessing and promoting social contextual factors and behavioral change processes, and instructing yoga in older adults.

Intervention Fidelity

Intervention fidelity is the extent to which the intervention delivery adheres to the protocol and addresses theoretical components. Lack of fidelity contributes to the risk of analysis error, or concluding that the intervention is not effective when it has not been implemented as designed (Sidani & Braden, 2011). Systematic attention to factors with potential to impede delivery of the intervention as planned is recommended as a standard approach to the implementation and evaluation of health behavior research (Bellg et al., 2004). The process methodology used in this study addressed fidelity to intervention design, quality monitoring and improvement, evaluation of participant receipt, and enactment of skills acquired during intervention sessions.

The intervention design is central to maintaining fidelity and minimizing drift from the intended protocol. The intervention dose, including program duration, session frequency, and session length, were standardized for this study. The Yoga for HEART Intervention was

manualized, with objectives and activities specified for each session. Flip charts were used to guide discussions. Each flip chart page, prepared prior to group sessions, highlighted a key concept to be covered in that session, with open space dedicated to information generated during group discussions. This assisted in standardizing presentations and facilitating conversations, enabling the interventionist to focus on group responses and reflections.

As the interventionist is the medium through which an intervention is delivered, interventionist preparation is essential to maintaining intervention fidelity (Sidani & Braden, 2011). The yoga instructor was trained as a WMT-based interventionist to facilitate delivery of the critical content in the Yoga for HEART Intervention. A manual was developed for this study with specific objectives for group sessions, content outlines, and learning activities guided by scripting. Practice and feedback from intervention experts minimized drift of interventionist skills over time (Bellg et al., 2004).

The Yoga for HEART Intervention manual integrated strategies to ensure participant enactment of learned skills. Receipt and enactment of intervention content were promoted through the use of weekly activity calendars, development of individual goals, and facilitation of group discussions regarding progress, accomplishments, perceived barriers, and strategies to overcome barriers. Group discussions included topics related to yoga, physical activity, and cardiovascular and overall health. Participant comprehension and perceptions of session content, group facilitation, and environmental characteristics were assessed continually. Throughout each session, the interventionist conducted formative assessment through group discussions of scripted questions documented on the flip chart and in field notes. Field notes included

information about each session using summarized observations of participant responses to each of the session's objectives.

An Index of Procedural Consistency was used to monitor the degree of implementation and the frequency and duration of activities, as a basis for quantifying intervention fidelity. The interventionist maintained a log evaluating each session, tracking tasks addressed and accomplished, time spent on tasks, and intervention delivery methods and materials. The investigator met with research mentors on a regular basis to discuss study progress, including recruitment, retention, implementation, data collection, data management, protocol deviation, and intervention fidelity.

Variables and Measurement

Variables categorized as demographic characteristics, acceptability, demand, implementation fidelity, and efficacy were measured using standardized questionnaires and procedures upon participant enrollment (T1) and immediately post-intervention (T2). Data collection equipment and supplies (e.g., packets, pencils, scales, tape measures, blood pressure cuffs, and accelerometers) were organized for portability and available at each data collection session. The study team coordinated individual data collection sessions lasting up to an hour, during which standardized questionnaires were read to participants and questions were clarified. Measurement strategies were standardized across intervention and Active Control conditions; measurement was conducted by a research assistant blinded to study condition. Data collection sessions were conducted in the yoga studio where the intervention was delivered to participants.

Demographic characteristics. Demographic characteristics were assessed at baseline (T1) to describe the target population and to ensure randomization processes minimized

allocation bias. Demographic variables included: (a) age; (b) gender; (c) race; (d) ethnicity; (e) educational level; (e) occupational status; and (f) economic status.

Intervention acceptability. Intervention acceptability is a reflection of participant expectations, preferences, and perceptions. The extent to which participants find an intervention acceptable determines the extent to which it may be appropriate for future full-scale testing. An intervention acceptability questionnaire administered to participants at T2 evaluated two key aspects of acceptability: (a) intervention components, including utility, effectiveness, credibility, and satisfaction; and (b) intervention delivery, including dose and format. Participants were surveyed regarding the extent to which they agreed with items representing each aspect of the intervention, using a scale ranging from one (strongly disagree) to five (strongly agree). They were also encouraged to describe how the intervention may be improved, providing narrative data as an additional evaluation source.

Intervention demand. Understanding the factors that influence attendance and attrition (intervention demand) contributes to the refinement of future intervention studies. An attendance log served as a class roster for each group session to track participation over time. Weekly attendance rosters were reviewed and phone calls were placed to any missing participants. An attrition log recorded when and why participants withdrew from the study, allowing the research team to evaluate acceptable and unacceptable intervention attributes. Participants who left the study were asked to share reasons for withdrawal. Attrition data were compared between intervention and control groups.

Implementation fidelity. Quality monitoring was used to address implementation fidelity, or the extent to which intervention sessions were delivered as planned. Implementation

fidelity was evaluated using field notes and an Index of Procedural Consistency. Field notes were documented and reviewed for each session, outlining delivery methods, use of resources, tasks accomplished, and time spent on each task. An Index of Procedural Consistency was used to evaluate the degree of implementation and the frequency and duration of activities as a basis for quantifying intervention fidelity. The Index of Procedural Consistency was designed to measure fidelity to intervention session objectives using a scale ranging from one (not at all delivered) to three (delivered very well). Intervention sessions were recorded via audiotape; an external reviewer randomly audited 25% of session audiotapes to monitor adherence to the study protocol, enhance the delivery of theory-based intervention components, and minimize protocol drift, through ongoing evaluation and feedback.

Behavioral change processes. Behavioral change process variables were measured at T1 and T2.

Self-knowledge. Self-knowledge was measured using the Self-Knowledge Inventory (SKI). The SKI is a set of three open-ended questions and three Likert-type items designed to elicit goals related to health and wellness and strategies to achieve these goals. Self-efficacy and outcome expectancy related to health goals and strategies were measured using a scale from one (strongly disagree) to five (strongly agree) (Frazier, Hooker, Johnson, & Kaus, 2000). Responses to open-ended questions were summarized using content analysis. Inter-rater reliability for the PSQ has ranged from 87% to 98% (Frazier et al., 2000).

Motivation appraisal. Motivation appraisal was measured using the Index of Readiness (IR; Fleury, 1994). The IR contains nine items on a scale ranging from one (strongly disagree) to five (strongly agree), with three subscales measuring revaluation of lifestyle, barrier

identification, and goal commitment. Total scale internal consistency has been reported at α = .89 (Fleury, 1994).

Self-regulation. Self-regulation was measured using the Index of Self-Regulation (ISR; Fleury, 1998). The ISR contains nine items on a scale from one (strongly disagree) to five (strongly agree), with three subscales measuring reconditioning, stimulus control, and behavioral monitoring. Internal consistency estimates of the ISR range from a Cronbach's alpha of .70 to .90, with a total scale re-test reliability of .82 (Fleury, 1998; Moore et al., 2006).

Social contextual resources. Social contextual resources were measured at T1 and T2. Social support was measured using the Social Support for Exercise Survey (SSES), a questionnaire that captures social support for physical activity from family and friends (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Internal consistency estimates of the SSES have ranged from a Cronbach's alpha of .84 to .91 in studies with older adults (Sallis et al., 1987). Community resources were assessed using the Perceived Environmental Support Scale (Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997). The Perceived Environmental Support Scale captures community resources for physical activity including recreation centers and walking trails. Test-retest correlations have ranged from r = .68 to r = .80 for items pertaining to neighborhood environment and community resources, respectively (Sallis et al., 1997).

Physical activity health behavior. Physical activity data was collected at T1 and T2 using the ActiGraph GT3X+ accelerometer (ActiGraph™, LLC, Pensacola, FL). Accelerometers are widely accepted by researchers as providing valid and reliable estimates of physical activity; the ActiGraph is the most commonly used brand of device (Bassett, Troiano, McClain, & Wolff, 2014; Cain, Conway, Adams, Husak, & Sallis, 2013; Cheung, Gray, &

Karunanithi, 2011). The ActiGraph GT3X+ is a triaxial accelerometer that captures human movement in three axes or planes (e.g., vertical, antero-posterior, and medio-lateral axes), providing a composite measure called the vector magnitude ($VM = \sqrt{(x^2+y^2+z^2)}$) (Aguilar-Farías, Brown, & Peeters, 2014). Summarizing data using the vector magnitude has been shown to enhance the precision of physical activity estimates, compared to collecting data in a single plane such as the vertical axis (Keadle, Shiroma, Freedson, & Lee, 2014).

The ActiGraph GT3X+ measures acceleration in specific time intervals or epochs. Acceleration data is sampled multiple times per second and converted to a digital signal, expressed as counts per minute (Cheung et al., 2011). Higher activity counts result from greater acceleration (Evenson, Buchner, & Morland, 2012). Accelerometers allow researchers to convert raw data counts into physical activity metrics, such as time spent in various intensities of physical activity (Bassett et al., 2014). Estimates of physical activity vary depending on the user-selected epoch length, the axes chosen for monitoring, and the cut points used to define the intensity of physical activity (Aguilar-Farías et al., 2014; Gorman et al., 2014; Evenson et al., 2012).

This study collected accelerometer data in all three axes and summarized raw activity counts using one-minute epochs, consistent with previous physical activity research in older adults (Copeland & Esliger, 2009; Gorman et al., 2014; Matthews, Hagströmer, Pober, & Bowles, 2012). Time spent in various intensities of physical activity were classified using the following established cut points in the vector magnitude: (a) sedentary behavior (< 200 counts per minute); (b) low intensity activity (200 – 2689 counts per minute); (c) moderate intensity activity (2690 – 6166 counts per minute); and (d) vigorous intensity activity (≥ 6167 counts per

minute) (Aguilar-Farías et al., 2014; Keadle et al., 2014; Sasaki, John, & Freedson, 2011). Non-wear time was defined as 90 consecutive minutes of 0 counts per minute (Hutto et al., 2013; Keadle et al., 2014; Peeters, Gellecum, Ryde, Farías, & Brown, 2013). The total activity counts per day (were calculated, including time spent in combinations of low, moderate, and vigorous physical activity (Bassett et al., 2014).

During the enrollment appointment (T1) and the post-intervention data collection session (T2), each participant was fitted with an ActiGraph GT3X+ accelerometer. Participants were asked to begin wearing the device on the following day for seven consecutive days, from the moment they woke up in the morning until they went to bed at night (Gorman et al., 2014; Hutto et al., 2013; Taraldsen, Chastin, Riphagen, Vereijken, & Helbostad, 2012). Seven-day monitoring periods have been routinely used in physical activity research studies with older adults (Keadle et al., 2014; Matthews et al., 2012). For data to be included in the analysis, participants must have worn the accelerometer for at least 4 valid days, with at least 10 hours of valid wear time per day (Cain & Geremia, 2011; Copeland & Esliger, 2009; Hart, Swartz, Cashin, & Strath, 2011).

Participants were provided with verbal, written, and pictorial instructions on how to wear the accelerometer (Aguilar-Farías et al., 2014; Hutto et al., 2013; Matthews et al., 2012). Each device was given to the participant with the ActiGraph GT3X+ threaded onto an elastic waist belt, and it was placed above the right frontal hip bone (i.e., iliac crest) (Gorman et al., 2014; Hutto et al., 2013; Matthews et al., 2012). The most commonly used body position for device attachment is at the hip, as it is closely associated with the body's center of gravity, and this location is practical for unobtrusive wear (Cheung et al., 2011; Keadle et al., 2014; Murphy,

2009). Accelerometers may be worn either under or over clothing, whichever is most comfortable to the participant, but it is essential that the device be positioned snugly against the body (Cain & Geremia, 2011; Hutto et al., 2013; Matthews et al., 2012). A photo depicting correct placement was included on the instruction sheet, and a note was placed on the device to indicate proper positioning (Matthews et al., 2012). Participants were asked not to wear the accelerometer any other way, including: (a) not in any pockets of clothing; (b) not in a handbag or backpack; and (c) not in a car trunk or glove compartment (Cain & Geremia, 2011).

As the ActiGraph GT3X+ is not waterproof, participants were requested to remove the device during water-based activities such as showering and swimming (Aguilar-Farías et al., 2014; Cain & Geremia, 2011). Participants were provided with a log sheet and asked to record the times the accelerometer was attached and removed each day, documenting the times and reasons for every occasion the device was removed (Aguilar-Farías, et al., 2014; Hutto et al., 2013; Keadle et al., 2014). This approach is useful when screening data to distinguish between wear time and non-wear time, and it promotes compliance by serving as a reminder (Cain & Geremia, 2011; Copeland & Esliger, 2009; Matthews et al., 2012). A contact number was provided in case participants had questions or concerns regarding the accelerometer or log sheet, and reminder telephone calls were placed to participants two days following each data collection appointment to encourage compliance with the protocol (Hutto et al., 2013; Matthews et al., 2012; Murphy, 2009).

Participants were provided with a pre-addressed, postage-paid return envelope and were instructed to return the device and log sheet immediately after completing the seven-day protocol (Hutto et al., 2013; Keadle et al., 2014; Matthews et al., 2012). A database was created using

serial numbers and critical dates to track the accelerometers, and the interventionist initiated follow-up telephone calls if the device was not returned within two weeks (Hutto et al., 2013; Matthews et al., 2012).

Data collected by the ActiGraph GT3X+ accelerometers were downloaded to a computer for analysis using the ActiLife 6 software platform and raw data were filtered with the low frequency extension for greater sensitivity to lower intensities of physical activity that are commonly performed by older adults (Aguilar-Farías et al., 2014; Cain et al., 2013; Gorman et al., 2014). Compliance and quality control checks were performed on the downloaded data, and log sheets were reviewed to ensure the accuracy of wear time algorithms and exclude non-wear time from the analysis (Aguilar-Farías et al., 2014). Raw acceleration data were summarized into 1-minute epochs and expressed as counts per minute (Copeland & Esliger, 2009; Gorman et al., 2014; Keadle et al., 2014). Total activity counts per day were calculated, and average daily time spent in sedentary, low, moderate, and vigorous intensity physical activity was classified using established cut points in the vector magnitude (Aguilar-Farías et al., 2014; Keadle et al., 2014; Sasaki et al., 2011).

Cardiovascular health outcomes. Cardiovascular health outcome variables including blood pressure (BP), body mass index (BMI), and body composition were measured at T1 and T2.

Blood pressure. Blood pressure (BP) was measured using an automated digital BP cuff, the Omron 705-IT. The Omron 705-IT model has been validated for use in previous research with adults according to the British Hypertension Society Protocol (BHS) and the European Society of Hypertension International Protocol (BHS-IP) (Coleman, Freeman, Steel, & Shennan,

2006; El-Assad, Topouchian, & Asmar, 2003). Blood pressure measurement followed standard procedures as outlined in ACSM, American Heart Association (AHA), and Joint National Committee (JNC 7) guidelines (ACSM, 2014b; Pickering et al., 2005; US Department of Health and Human Services [USDHHS], 2003). To measure BP, the participant was seated comfortably in a chair for at least five minutes, with the back supported, feet on the floor, legs uncrossed, and arms supported at heart level. The participant was encouraged to relax as much as possible and to not talk during the procedure. An appropriate-sized BP cuff (with the cuff bladder encircling at least 80% of the arm) was placed snugly on the upper arm at the level of the heart (i.e., mid-sternum). The participant was asked to remove any clothing that covered the location of cuff placement. Blood pressure was measured in both arms; if a difference was found, the arm with the higher value was used. A minimum of two measurements were taken at intervals of at least one minute, and the average of those readings were used to represent the participant's BP (ACSM, 2014a; Pickering et al., 2005; USDHHS, 2003). If the individual's BP was ≥ 160/100 mmHg, they were referred to their primary care physician for follow-up and medical clearance prior to study participation (ACSM, 2014b).

For accurate BP measurement, the data collector: (a) was properly trained in the techniques of BP measurement; (b) used an accurate and properly maintained device; (c) positioned the participant appropriately; (d) selected the correct cuff size and positioned it correctly; and (e) performed the measurement using the automated method and accurately recorded the values obtained (Pickering et al., 2005).

Body mass index. Body mass index was computed as weight in kilograms divided by height in meters squared. Height was measured with a stadiometer using a standardized

protocol. The participant was asked to remove their shoes and stand up straight with the heels together and the head level, looking straight ahead. They were asked to take a deep breath and hold it as the height is recorded to the nearest 0.5 inch (ACSM, 2014b). Weight was measured using a calibrated Tanita digital scale (model HD-357) that has been validated in previous research with adults (Yorkin, Spaccarotella, Martin-Biggers, Quick, & Byrd-Bredbenner, 2013). To obtain an accurate weight measurement, the participant was instructed to remove their shoes and outer layers of clothing, empty all pockets, remove jewelry and cell phones, and step on the scale. The data collector recorded the participant's weight to the nearest 0.1 lb (ACSM, 2014b; Swain, 2014).

Body composition. Body composition was determined by measuring waist-to-hip ratio (WHR) using waist and hip circumferences obtained using a non-stretch tape measure. Waist circumference was measured at the smallest circumference above the navel and below the ribs; hip circumference was measured as the largest circumference around the buttocks above the gluteal fold. Hip and waist measurements were performed using the following standardized protocol: (a) the data collector stood on the right side of the participant; (b) measurements were taken at the end of a normal exhalation by the participant; (c) the measuring tape was held parallel to the floor and pulled to lay flat without compressing the skin; and (d) the mean of two measurements were used for each location (ACSM, 2014a; Swain, 2014).

Functional fitness outcomes. Functional physical fitness outcomes, including endurance, strength, flexibility, and balance, were measured at T1 and T2 using the Senior Fitness Test (SFT; Rikli & Jones, 2013). The SFT is a battery of test items that measure the physical capacity of older adults to perform common everyday activities. The test is considered

a functional fitness test as it is designed to assess the physical characteristics needed for functional mobility in later life. Functional fitness is defined as having the physical capacity to perform everyday activities safely and independently without undue fatigue. The SFT includes six test items, including the (a) 30-second chair-stand; (b) 30-second arm curl; (c) 2-minute step; (d) chair sit-and-reach; (e) back scratch; and (f) 8-foot up-and-go tests. Each item in the SFT has documented validity and reliability in community-based research settings (Rikli & Jones, 2013).

Aerobic endurance. Aerobic endurance, defined as the capacity to perform large-muscle activity over an extended time, was measured with the 2-minute step test. The test involves marching continuously in place, stepping as many times as possible in 2 minutes. Aerobic endurance is needed to perform a variety of activities including walking distances, stair climbing, shopping, and participating in recreational activities (Rikli & Jones, 2013).

Upper and lower body strength. Upper body strength was measured with the 30-second arm curl test. The test involves counting the number of times a person can curl a hand weight, 5 pounds for women and 8 pounds for men, in 30 seconds. Upper body strength is important for performing household and other activities involving lifting and carrying things such as groceries, grandchildren, and pets (Rikli & Jones, 2013).

Lower body strength was measured using the 30-second chair stand test. The test involves counting the number of times, within a 30-second period, that a person can rise to a full stand from a seated position with the arms folded across the chest. Lower-body strength is an important aspect of fitness in older adults because of its role in everyday activities such as walking, stair climbing, maintaining balance, and getting in and out of a chair, bathtub, or car (Rikli & Jones, 2013).

Upper and lower body flexibility. Upper body flexibility was measured using the back scratch test. The test involves reaching one hand over the shoulder and down the back, and the other hand around the waist and up the middle of the back, trying to bring the fingers of both hands together as much as possible. The score is the number of inches, plus or minus, between the extended middle fingers. Upper body flexibility is important for performing common tasks such as getting dressed, combing hair, and reaching for a seat belt. Reduced upper-body flexibility can result in pain and increased risk of injury and disability in later years (Rikli & Jones, 2013).

Lower-body flexibility was measured using the chair sit-and-reach test. The test involves sitting at the edge of a chair, with one leg extended and the other foot flat on the floor. With hands on top of each other and arms outstretched, the participant reaches as far forward as possible toward the toes. The score is the number of inches, plus or minus, between the tips of the middle fingers and the toes. Lower body flexibility is important for healthy posture and for mobility tasks such as walking, stair climbing, and getting in and out of a car or bathtub. Lower-body flexibility also helps prevent musculoskeletal injuries and reduces the risk of falling (Rikli & Jones, 2013).

Dynamic balance. Dynamic balance was measured using the 8-foot up-and-go test. The test involves getting up from a seated position, walking as quickly as possible around a cone that is eight feet away, and returning to the seated position. Dynamic balance is needed for a range of activities such as getting up to answer the phone, use the bathroom, attend to something in the kitchen, and maneuver quickly enough to get off a bus in a timely manner (Rikli & Jones, 2013).

Data Management and Analysis

Coded data collection forms, completed at each measurement time point (T1 – T2), were reviewed for missing information. Data were entered twice using SPSS. Two versions of the database were compared, with inconsistencies checked against raw data forms. Individual data were entered using an identification number. Personal identifiers were kept separate from questionnaires and other data collection forms. Raw data were stored in a locked filing cabinet. No identifiers were included in any reports or publications that resulted from this study.

This feasibility study employed a two-group, repeated measures, experimental design. Preliminary analysis included descriptive statistics to characterize sample demographics and variable measures. Frequencies, means, and standard deviations were computed on all measures. Data displays were examined for normal distribution, outliers, and missing data, to be transformed prior to analysis as appropriate. Any missing data were handled with mean imputation. Descriptive statistics were used to summarize acceptability, demand, and implementation fidelity of the Yoga for HEART Intervention. A repeated measures analysis of variance (ANOVA) was conducted to evaluate the efficacy of the intervention in promoting behavioral change processes, building social contextual resources, increasing physical activity health behavior, improving cardiovascular health outcomes, and enhancing functional fitness within the Intervention and Active Control groups over time. A one-way analysis of covariance (ANCOVA) was conducted to examine differences in theoretical mediators and health outcomes between groups over time, with baseline data for each variable entered as a covariate. A p value $\leq .05$ was used to evaluate the statistical significance of results.

Chapter 4

RESULTS

The purpose of this study was to test the feasibility (i.e., acceptability, demand, implementation fidelity, and effects) of the Yoga for HEART (Health Empowerment and Realizing Transformation) Intervention in community-dwelling older adults at risk for cardiovascular disease (CVD). The Yoga for HEART Intervention focused on enhancing motivation for physical activity to promote cardiovascular and overall health. The research was designed to increase physical activity behavior and improve health outcomes through increased awareness and use of social contextual resources and behavioral change processes. Intervention acceptability, demand, and implementation fidelity were evaluated among participants in the Intervention group. The intended effects on theoretical mechanisms and outcomes within and between Intervention and Active Control groups over time were analyzed. Study results are presented according to Specific Aims, and are prefaced with a description of the sample and psychometric properties of measures used.

Sample Description

Figure 4 outlines the recruitment flowchart (Schulz, Altman, & Moher, 2010). In summary, 37 individuals expressed interest in the study and were screened for eligibility. Fifteen individuals met inclusion criteria, provided informed consent to participate in the study, and were randomized to Intervention or Active Control conditions. In total, there was one Intervention group and one Active Control group. Eleven participants completed the study. Four participants (three participants in the Intervention group and one in the Active Control group) did not complete the study due to (a) scheduling conflicts; (b) caregiving responsibilities;

and (c) elective surgery. One participant withdrew from the study following baseline data collection and randomization; this individual did not attend any intervention sessions.

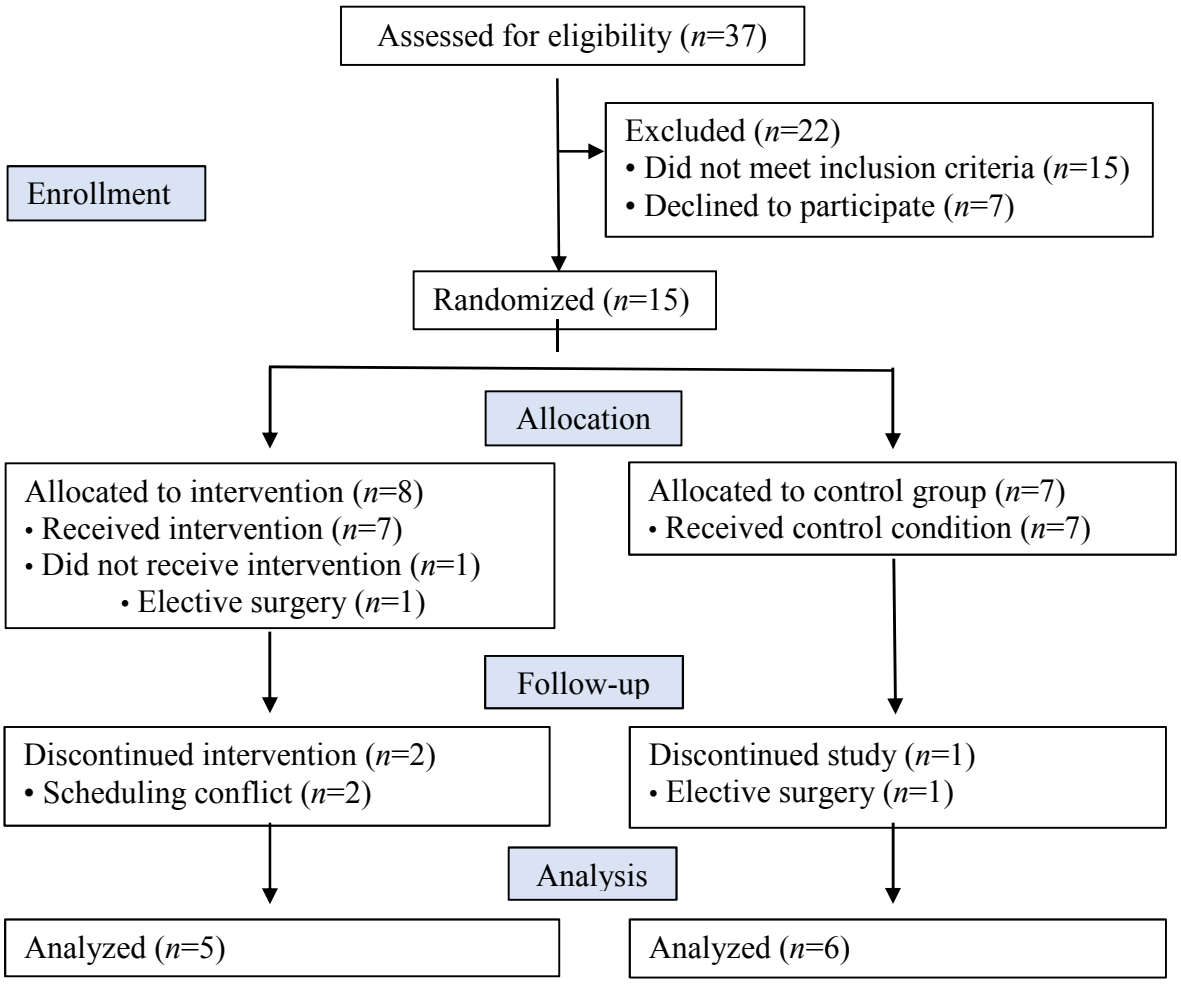

Figure 4. CONSORT flow diagram of Yoga for HEART participants.

Demographic characteristics of study participants are presented in Table 4. Participants ranged in age from 50 to 79 years, with a mean of 65 (*SD* = 8.5) years. Ninety-three percent of participants were female. The majority of participants were White (100%) with some college education (93%). Level of educational attainment ranged from 12 to 21 years, with a mean of 16

(*SD* = 2.4) years. Sixty percent of the study participants were retired, 27% were employed full-time, and 13% worked as volunteers. Several participants described themselves as unpaid caregivers to their grandchildren, parents, or spouses. Thirty-three percent of participants were married, 33% were divorced, 13% were widowed, 13% were never married, and 7% were separated. Twenty-seven percent of participants reported feeling insecure about paying their monthly bills. One participant described their living situation as homeless.

Table 4
Demographic Characteristics of Study Participants

	Intervention Group (n = 8)	Control Group (n = 7)	Total (N = 15)
Age			
Range	50 – 79	58 – 77	50 – 79
Mean (standard deviation)	62.38 (9.3)	68.57 (6.7)	65.27 (8.5)
Gender			
Female	7 (87.5%)	7 (100%)	14 (93.3%)
Male	1 (12.5%)	0	1 (6.7%)
Race			
White	8 (100%)	7 (100%)	15 (100%)
Ethnicity			
Non-Hispanic	8 (100%)	7 (100%)	15 (100%)
Years of Education			
Mean (standard deviation)	16.3 (2.5)	16.6 (2.4)	16.4 (2.4)
12 years	8 (100%)	7 (100%)	15 (100%)
Some college	7 (87.5%)	7 (100%)	14 (93%)
≥ 4 years of college	3 (37.5%)	3 (42.9%)	6 (40%)
Employment Status			
Retired	3 (37.5%)	6 (85.7%)	9 (60%)
Full time	3 (37.5%)	1 (14.3%)	4 (26.7%)
Volunteer	2 (25%)	0	2 (13.3%)
Marital Status			
Married	2 (25%)	3 (42.9%)	5 (33.3%)
Separated	1 (12.5%)	0	1 (6.7%)
Divorced	3 (37.5%)	2 (28.6%)	5 (33.3%)
Widowed	1 (12.5%)	1 (14.3%)	2 (13.3%)
Never married	1 (12.5%)	1 (14.3%)	2 (13.3%)
Economic Status			
Able to pay monthly bills	6 (75%)	5 (71.4%)	11 (73.3%)
Not able to pay monthly bills	2 (25%)	2 (28.6%)	4 (26.7%)

Psychometric Properties of Measures

Descriptive analyses included means, standard deviations, skewness, kurtosis, and when appropriate, correlation of item to scale (Tables 5 – 12). Cronbach's alpha reliability scores were calculated for scales with inter-related items, including the Index of Readiness (IR; Fleury, 1994), the Index of Self-Regulation (ISR; Fleury, 1998), and the Social Support for Exercise Survey (SSES; Saelens et al., 2003; Sallis et al., 1987).

Table 5
Mean, Standard Deviation, Skewness, and Kurtosis of Self-Efficacy and Outcome Expectations

Item	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*
1. How able do you feel that you can perform your activities listed, on a daily basis?	2.63	.52	-.64	.75	1.48	1.48
2. How likely do you think it is that you will achieve your goals?	2.50	.76	-1.32	.75	.88	1.48

Table 6
Mean, Standard Deviation, Skewness, Kurtosis, and Correlation with Scale of the IR

Item	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*	Correlation with Total
1. I think about what might happen if I don't begin a program of physical activity.	4.27	.70	-.43	.58	-.67	1.12	.32
2. I don't participate in physical activity as often as I feel that I could.	3.93	1.22	-1.21	.58	1.01	1.12	-.20
3. I think that I need to change some of the things that keep me from being physically active.	4.13	.92	-.94	.58	.52	1.12	.50
4. I have planned new ways to stay physically active.	3.53	.74	-.13	.58	.18	1.12	.20
5. I have thought about new ways I can make physical activity fit into my life.	3.73	.70	.43	.58	-.67	1.12	.82
6. I have a plan for how to overcome barriers to regular physical activity.	3.53	.92	-.11	.58	-.48	1.12	.12
7. I am willing to make sacrifices in order to participate in physical activity on a daily basis.	4.13	.74	-.23	.58	-.97	1.12	.76
8. I am determined to succeed in making physical activity a part of my life.	4.47	. 52	.15	.58	-2.31	1.12	.42

9.	I am committed to making lasting changes in the ways that I stay physically active.	4.40	.51	.46	.58	-2.09	1.12	.67

Table 7

Mean, Standard Deviation, Skewness, Kurtosis, and Correlation with Scale of the ISR

	Item	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*	Correlation with Total
1.	I think of the benefits of regular physical activity.	4.27	.70	-.43	.58	-.67	1.12	.61
2.	I remind myself of the good I am doing by participating in physical activity.	3.87	.92	-.35	.58	-.48	1.12	.74
3.	I remind myself of the importance of physical activity.	4.07	.70	-.09	.58	-.67	1.12	.83
4.	I keep track of the ways that I stay physically active.	3.07	1.10	-.15	.58	-.68	1.12	.83
5.	I watch for signs of progress as I stay physically active.	3.53	1.19	-.68	.58	-.08	1.12	.75
6.	I monitor myself to see if I am meeting my goals for physical activity.	3.00	1.20	.29	.58	-.75	1.12	.88
7.	I have learned new habits that help me to participate in physical activity.	3.27	1.22	-.05	.58	-.72	1.12	.74
8.	I have learned new ways to keep physically active.	3.33	1.05	.08	.58	-1.1	1.12	.72
9.	I have learned to make changes in my physical activity that I can live with.	3.47	1.19	-.50	.58	-.26	1.12	.75

Table 8

Mean, Standard Deviation, Skewness, Kurtosis, and Correlation with Scale of the SSES

	Item	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*	Correlation with Total
1.	Participated in physical activity with me.	3.07	1.10	.22	.58	.11	1.12	.59
2.	Offered to participate in physical activity with me.	2.67	1.23	.48	.58	.16	1.12	.79
3.	Gave me helpful reminders to be physically active.	3.00	1.51	.00	.58	-1.58	1.12	.71
4.	Gave me encouragement to be physically active.	3.80	1.27	-.79	.58	-.08	1.12	.65
5.	Changed their schedule so we could be physically active together.	2.33	1.29	1.12	.58	.76	1.12	.74

6.	Discussed physical activity with me.	3.67	1.23	-.57	.58	-.22	1.12	.70
7.	Helped by scheduling other commitments around my activity.	2.40	1.18	.87	.58	.20	1.12	.62
8.	Asked me for ideas on how they might be more physically active.	2.33	1.29	.66	.58	-.51	1.12	.29
9.	Talked about how much they like to stay physically active.	3.93	.96	-.41	.58	-.75	1.12	.21

Table 9

Mean, Standard Deviation, Skewness, and Kurtosis of the NEQ

	Item	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*
1.	During the past 6 months how often have you walked or strolled in your neighborhood?	3.93	.96	-.41	.58	-.75	1.12
2.	During the past 6 months how often have you walked or done any other physical activity with your neighbors?	2.27	1.22	.77	.58	.11	1.12
3.	During the past 6 months how often have you gone to a neighborhood park for walks or other physical activities?	1.80	1.01	.93	.58	-.35	1.12
4.	There are no hills in my neighborhood.	1.87	1.06	1.13	.58	.32	1.12
5.	My neighborhood streets are well lit at night.	2.07	1.34	.69	.58	-1.45	1.12
6.	There are safe places to walk in my neighborhood.	4.00	1.07	-.81	.58	-.40	1.12
7.	There are many attractive natural sights in my neighborhood.	4.27	1.16	-1.86	.58	3.54	1.12
8.	Many people walk and participate in physical activities frequently in my neighborhood.	3.60	1.06	.12	.58	-1.17	1.12
9.	My community gets its fair share of public money to spend on recreation areas and facilities.	3.00	1.25	-.11	.58	-.65	1.12

Table 10

Mean, Standard Deviation, Skewness, and Kurtosis of Time Spent in Physical Activity (mins/day)

	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*
Sedentary Bouts	144.93	71.12	1.04	.58	.27	1.12
Light Intensity Physical Activity	759.13	57.58	-.04	.58	-.64	1.12
Moderate Intensity Physical Activity	64.07	22.41	-.08	.58	-1.33	1.12
Vigorous Intensity Physical Activity	2.40	1.60	1.06	.58	.37	1.12

Table 11

Mean, Standard Deviation, Skewness, and Kurtosis of Cardiovascular Health Outcomes

	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*
Systolic Blood Pressure (mmHg)	125.20	15.87	.05	.58	-.39	1.12
Diastolic Blood Pressure (mmHg)	80.13	10.86	-.07	.58	-1.20	1.12
Body Mass Index	25.57	5.35	1.15	.58	.48	1.12
Waist-Hip Ratio	.86	.09	.67	.58	.91	1.12

Table 12

Mean, Standard Deviation, Skewness, and Kurtosis of Functional Fitness Outcomes

	Mean	*SD*	Skewness	*SE*	Kurtosis	*SE*
Chair Stand Test (# in 30 sec)	13.67	2.50	-.64	.58	.33	1.12
Arm Curl Test (# in 30 sec)	19.33	4.82	1.27	.58	2.32	1.12
2-Minute Step Test (# in 2 min)	100.80	24.57	-.95	.58	1.41	1.12
Sit-and-Reach Test (in.)	1.15	4.15	-1.09	.58	.80	1.12
Back Scratch Test (in.)	-1.47	5.87	-2.49	.58	7.30	1.12
8-Foot Up-and-Go Test (sec)	5.39	.71	.43	.58	-.56	1.12

Self-knowledge was evaluated using the Self-Knowledge Inventory (SKI). The SKI item addressing self-efficacy had a non-normal distribution at T1 (p = .00) with skewness of -.46 (*SE* = .58) and kurtosis of -2.10 (*SE* = 1.12) and, respectively. Sixty percent of participants felt "sure" of their ability to achieve their personal health goals.

The SKI item addressing outcome expectancy had a non-normal distribution at T1 (p = .00), with skewness of -1.07 (*SE* = .58) and kurtosis of -.11 (*SE* = 1.12). Sixty-seven percent of participants reported they felt "likely" to achieve their health goals.

The total score for the IR was normally distributed at T1, with skewness of -.11 (*SE* = .58) and kurtosis of -.46 (*SE* = 1.12). Cronbach's alpha for the IR was $\alpha = .63$. Items in the IR had a normal distribution, with the exception of the item stating, "I don't participate in physical activity as often as I could." The mean and standard deviation of responses to this item were 3.93 (1 – 5 scale) and 1.22, with skewness of -1.21 (*SE* = .58) and kurtosis of 1.01 (*SE* = 1.12). Cronbach's alpha for this item was $\alpha = -.20$, indicating a negative correlation with other items in the scale. The majority of participants (87%) felt that they didn't participate in physical activity as often as they could. When this item was removed from the analysis, Cronbach's alpha for the total scale increased to $\alpha = .78$. Cronbach's alpha scores for three IR subscales (i.e., re-evaluation

of lifestyle, identification of barriers, and goal commitment) were α = .39, α = .71, and α = .75, respectively.

The total score for the ISR had a normal distribution at T1, with skewness of .02 (*SE* = .58) and kurtosis of -.04 (*SE* = 1.12); Cronbach's alpha for the total scale was α = .93. Items in the ISR were normally distributed, with internal consistency estimates ranging from α = .61 to α =.88. Cronbach's alpha scores for three ISR subscales (i.e., reconditioning, stimulus control, and behavioral monitoring) were α = .82, α = .93, and α = .90, respectively.

The total score for the SSES was normally distributed at T1, with skewness of .35 (*SE* = .58) and kurtosis of .54 (*SE* = 1.12). Cronbach's alpha for the total scale was α = .86. Items in the SSES had normal distributions, with the exception of the item stating, "During the past three months, my family, friends or household members changed their schedule so we could be physically active together." The mean and standard deviation of responses to this item were 2.33 (1 – 5 scale) and 1.29, with skewness of 1.12 (*SE* = .58) and kurtosis of .76 (*SE* = 1.12); Cronbach's alpha for this item was α = .74. Most participants reported that friends and family members were unlikely to change their schedules to accommodate their plans for physical activity. When this item was removed from the analysis, Cronbach's alpha for the total scale decreased to α = .83.

Community and environmental resources were measured using the Neighborhood Environment Questionnaire (NEQ), which inquired about neighborhood characteristics, community resources for participating in physical activity, and the extent to which participants walk or see others walk in the neighborhood (Saelens et al., 2003; Sallis et al., 1997). Results of measures in this item are described, but were not included in the inferential analysis, as the items

in the scale are not interrelated. Most participants described their neighborhood as residential (67%) or rural (27%). Some reported living in mixed residential/commercial areas (7%). On a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree), mean scores of items inquiring about neighborhood characteristics pertaining to hilliness, lighting at night, attractive natural sights, frequency of others being active, and safety varied widely with means of 1.80, 2.07, 4.27, 3.60, and 4.00, respectively. Seventy-three percent of participants reported traveling outside of their neighborhood to engage in physical activity; distance traveled ranged from 1 to 45 miles.

Moderate-intensity physical activity data had a normal distribution at T1, with skewness of -.08 (*SE* = .58) and kurtosis of -1.33 (*SE* = 1.12). Daily time spent in moderate-intensity physical activity ranged from 27 to 94 minutes with a mean of 64.07 minutes (*SD* = 15.87), as measured by the ActiGraph GT3X+ accelerometer.

Systolic and diastolic blood pressure (BP) data were normally distributed at T1, with skewness of .05 (*SE* = .58) and -.07 (*SE* = .58) and kurtosis of -.39 (*SE* = 1.12) and -1.20 (*SE* = 1.12), respectively. Systolic BP ranged from 97 to 155 mmHg (*M* = 125.20, *SD* = 15.87) and diastolic BP ranged from 63 to 98 mmHg (*M* = 83.55, *SD* = 8.64).

Body mass index (BMI) data had a non-normal distribution at T1, with skewness of 1.15 (*SE* = .58) and kurtosis of .46 (*SE* = 1.12). Body mass index ranged from 19.92 to 37.77 with a mean of 25.57 (*SD* = 5.35). At baseline, three participants were classified as overweight (i.e., BMI ranging from 25.0 to 29.9) and three were obese (i.e., BMI ≥ 30; CDC, 2017).

Waist-hip ratio (WHR) data were normally distributed at T1, with skewness of .67 (*SE* = .58) and kurtosis of .914. Waist-hip ratio ranged from .74 to 1.07 with a mean of .86 (*SD*

= .09). Abdominal obesity, an independent risk factor for CVD, is defined as having a WHR ≥ .85 in adult women and ≥ .90 in adult men (WHO, 2012). At baseline, 11 out of 15 participants were classified as having abdominal obesity (79%).

Waist circumference data had a normal distribution at T1, with skewness of 1.14 (*SE* = .58) and kurtosis of .35 (*SE* = 1.12). Waist circumference ranged from 29.0 in. to 45.5 in. with a mean of 34.8 in. (*SD* = 5.27). A waist circumference > 35 inches in women, and > 40 inches in men, is a risk factor for obesity-related conditions, including hypertension, coronary artery disease, and type 2 diabetes (CDC, 2015). At baseline, 2 out of 15 participants had waist circumferences > 35 inches, and 3 participants had waist circumferences > 40 inches.

Functional fitness test scores, including data gathered from the chair stand, arm curl, 2-minute step, sit-and reach, and 8-foot up-and-go tests, were normally distributed at baseline. Back scratch test scores had a non-normal distribution at T1, with skewness of -2.49 (*SE* = .58) and kurtosis of 7.30 (*SE* = 1.12). Back scratch test scores ranged from -20.0 in. to 3.5 in. with a mean of -1.47 in. (*SD* = 5.87). Two participants had limited range of motion due to a history of shoulder joint injury and/or surgery.

Table 13 presents the correlation matrix for variables measured at baseline.

Table 13

Correlation Matrix of Baseline Measures

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Self-Efficacy	1															
2	Outcome Expectancy	.43	1														
3	Index of Readiness	-.11	-.05	1													
4	Index of Self-Regulation	-.47	-.34	.72*	1												
5	Social Support for Exercise Survey	.03	-.26	.17	.59	1											
6	Moderate-Intensity Physical Activity	.20	.57	.16	-.20	-.15	1										
7	Systolic Blood Pressure	-.11	-.28	.23	.32	.19	-.26	1									
8	Diastolic Blood Pressure	.04	.14	.00	-.06	-.28	-.31	.39	1								
9	Body Mass Index	.64*	.56	.16	-.09	-.08	-.04	-.28	.30	1							
10	Waist-Hip Ratio	.20	.06	.46	.37	.14	-.07	.05	.20	.62*	1						
11	Chair Stand	.30	.63*	.23	-.14	-.43	.48	-.23	.13	.51	.23	1					
12	Arm Curl	.01	.34	.26	.07	-.37	.04	-.35	.09	.48	.19	.83**	1				
13	Step Test	.29	.60*	.19	-.19	-.24	.53	-.37	-.12	.34	.06	.83**	.70*	1			
14	Sit-and-Reach	-.35	.48	-.16	-.06	-.14	.49	.07	.03	-.32	-.41	.38	.20	.42	1		
15	Back Scratch	.08	-.07	-.01	.04	.41	.40	.38	-.07	-.48	-.31	-.04	-.35	.17	.40	1	
16	Up-and-Go	-.43	-.32	.14	.48	.19	-.59	.38	-.16	-.10	.14	-.29	.04	-.35	-.08	-.41	1

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

Specific Aim 1. The first aim of this study was to examine the feasibility of the Yoga for HEART Intervention among community-dwelling older adults at risk for CVD, evaluated in terms of acceptability, demand, and implementation.

Intervention Acceptability. Acceptability of the Yoga for HEART Intervention was evaluated using participant feedback surveys and investigator field notes. Participant evaluation included three open-ended questions and five Likert-type items (1 – 5 scale ranging from "not at all" to "very much") to elicit satisfaction with the intervention content and suggestions for future programs. Participant responses are summarized in Table 14.

Table 14
Mean, Standard Deviation, and Range of Responses to the Intervention Acceptability Survey

		Mean	*SD*	Minimum	Maximum
1.	The program helped me to learn more about myself.	4.8	.50	4	5
2.	The program helped me to gain confidence in practicing yoga and being more physically active.	5.0	.00	5	5
3.	The program helped me to establish a yoga practice and engage in other types of physical activity.	4.8	.50	4	5
4.	The program helped me to gather support for yoga and physical activity from family and friends.	3.5	1.29	2	5
5.	The program helped me to find other resources for yoga and physical activity in my community.	4.8	.50	4	5

Narrative responses to the open-ended questions from the Yoga for HEART Intervention acceptability survey included the following statements:

- I loved learning about the specific poses and the breathing exercises.
- I loved how the instructor broke down the movements and told us their meaning.
- The instructor was careful not to push too hard – made it a safe and healthy environment.
- I loved how they broke down the movements and made it much easier to learn.
- The instructor was very good at teaching the proper way to do exercise and giving alternatives for poses.
- I became more respectful of limitations of my body and to use modifications.
- I found using the props very beneficial.

- I loved the emphasis on the importance of movement and exercise and the awareness of what it takes to make our bodies healthy and how critical it is to move more.
- I appreciate the positive changes.
- I liked the consistency of the weekly classes.
- It has set a great tone for future workouts and an awareness to keep moving.
- I loved the community of other women in my age group. I particularly appreciated that they were healthy.
- It has been a great group of women.
- It was wonderful having "community." The women in the group were supportive and friendly. I'm going to continue exercising with at least one of the women in class.
- I loved the bits of wisdom shared throughout, the sense of community, and the bright, caring attitude of the instructor.
- The instructor was so supportive, kind, and caring.
- The instructor was a great teacher, considerate, kind, and helpful.
- What a gratifying experience.
- I'm so grateful for the program. Thank you.
- Thank you. It's been a great experience and I'm sad it's over.

A majority of participants reported enjoying the Yoga for HEART program and many expressed an interest in continuing the program beyond 12 weeks. Several participants would have preferred meeting more frequently than once per week. One individual would have preferred a more strenuous physical practice, while another would have preferred to practice yoga at a slower pace. Narrative data and field notes revealed that many participants expressed gratitude for the ability to practice yoga in a community of supportive women with similar goals and values related to health and wellness.

Intervention demand. Intervention demand, as indicated by attendance and attrition rates, was similar among participants in the Intervention and Active Control groups. Figure 5 illustrates the proportion of individuals who attended each session by group assignment. Intervention group participants attended an average of 7.6 out of 12 sessions (63%); Active

Control group participants attended an average of 7.5 out of 12 sessions (63%). Twenty percent of participants in the Intervention group attended nine sessions; 40% attended eight sessions; 20% attended seven sessions; and 20% attended six sessions. Reasons for not attending included illness, healthcare appointments, caregiving responsibilities, memorial service attendance, severe weather conditions, traveling out of town, entertaining holiday visitors, and simply forgetting. Several participants had scheduling conflicts or competing priorities (e.g., helping with a church pageant; waiting for package deliveries or service professionals to arrive at home). Participants were invited to bring a guest to each session. One participant brought a guest to four sessions; two participants brought a guest to one session. Guests included friends and family members who were interested in the content, but did not qualify for, or enroll in, the study.

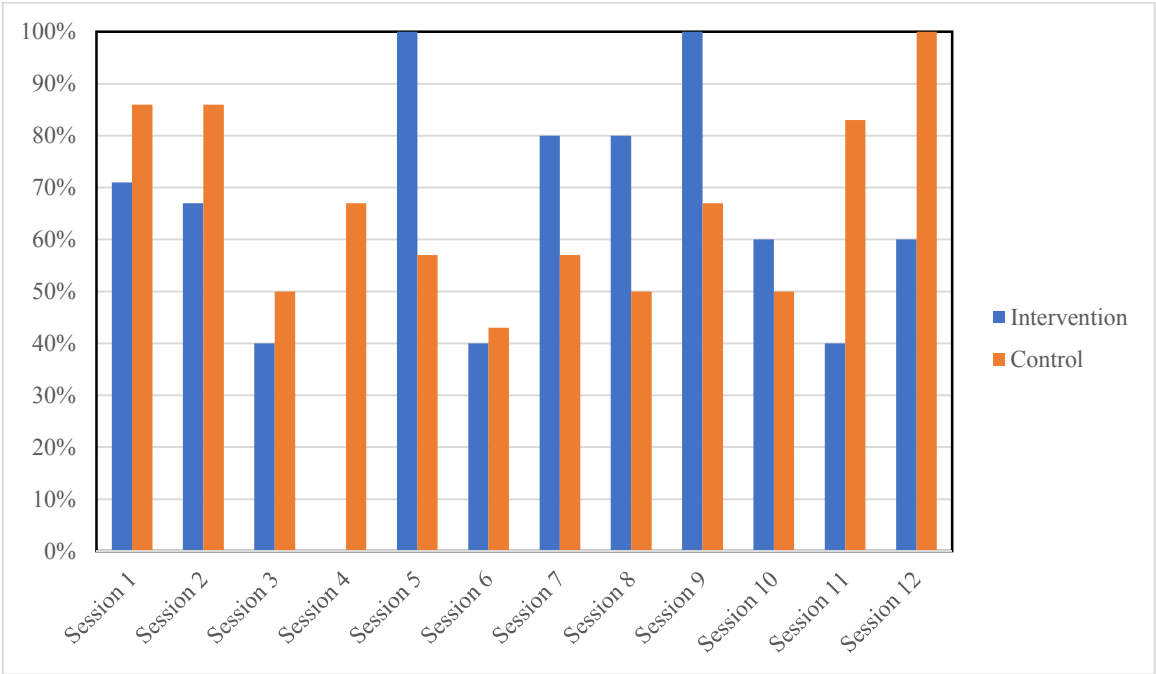

Figure 5. Attendance at intervention and control group sessions.

Four participants were lost to attrition (27%). One participant was randomized to the Intervention group but withdrew from the study prior to attending any group sessions; this individual had elective surgery. Two participants in the Intervention group withdrew from the study after attending one session; both had competing responsibilities at work and home, including managing a business and caring for an older parent with health needs. One participant in the Active Control group withdrew from the study after four sessions; this individual also had elective surgery. One participant withdrew from the study during week 3 because they felt they were not flexible enough to do yoga; the instructor reached out to this participant and encouraged them to practice yoga at their own pace, using modifications and props, including a chair as needed. The participant declined to use a chair, but returned to group sessions during week 5, using props to modify yoga postures and accommodate their individual needs. They expressed a sense of satisfaction in returning to the study and continued to attend group sessions until the last day of the program. Once the study was complete, this participant contacted the instructor to share that they had started doing yoga at the senior center twice per week.

Implementation fidelity. Implementation fidelity of the Yoga for HEART Intervention in a community setting among older adults at risk for CVD was evaluated through survey and observation. Each weekly group session lasted approximately 60 minutes and included between two and six participants, one guest, and the interventionist. The study was conducted from September 2017 to February 2018. Group sessions were not scheduled on holidays but continued weekly through the holiday season.

Field notes documenting the delivery of each session provided time for the interventionist to review the session and assess participant receipt and enactment. The extent to which

objectives for each intervention session were delivered as planned was evaluated with an Index of Procedural Consistency using a scale ranging from 1 (very little) to 3 (very well) by the interventionist immediately after each group session. An external reviewer with expertise in theory-based intervention evaluated 25% of the sessions via audiotape. Evaluation supported that session objectives were delivered as planned very well in 70% of sessions, and to a considerable in degree 30% of sessions. Rationale for delivering session objectives to a considerable degree was due to limited time. Several participants arrived late to each session and/or left early for various reasons, such as healthcare appointments, caregiving duties, and transportation issues.

Specific Aim 2. The second aim of this feasibility study was to evaluate the efficacy of the Yoga for HEART Intervention in increasing behavioral change processes, social contextual resources, physical activity health behavior, cardiovascular health outcomes, and functional fitness outcomes among community-dwelling older adults at risk for CVD. The following sections describe the results of repeated measures analysis of variance (ANOVA) and analysis of covariance (ANCOVA) examining changes over time in theoretical mechanisms and outcome variables within and between Intervention and Active Control groups. Where main effects or interactions were statistically significant, analysis of planned contrasts were conducted, and Bonferroni corrections were applied to adjust for multiple comparisons. One participant had missing data at T2 on functional fitness test scores; in this case, missing values were replaced with the mean score of each missing variable. A p value $\leq .05$ was used to evaluate significance.

Table 15 outlines the behavioral change processes, social contextual resources, physical activity behavior, cardiovascular health, and functional fitness outcomes in the Intervention and

Active Control groups whose means were analyzed for change over time. Gain scores for theoretical mechanisms and outcome variables are presented in Table 16.

Table 15

Mean and Standard Deviation of Theoretical Mechanisms and Outcomes

		Baseline (T1)						12 Weeks (T2)					
		Intervention (n = 5)		Control (n = 6)		Total (N = 11)		Intervention (n = 5)		Control (n = 6)		Total (N = 11)	
	Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
1.	Self-Efficacy Total	2.40	.55	2.50	.55	2.45	.52	2.60	.55	2.50	.55	2.55	.52
2.	Outcome Expectancy Total	3.00	.00	2.67	.52	2.82	.41	2.80	.45	2.67	.52	2.73	.47
3.	Index of Readiness Total	36.20	2.28	37.33	4.27	36.82	3.40	36.8	2.39	36.5	5.68	36.64	4.30
4.	Index of Self-Regulation Total	28.80	3.27	35.17	10.46	32.27	8.38	36.40	1.51	36.83	6.05	36.64	4.30
5.	Social Support for Exercise Total	25.20	3.77	30.33	6.28	28.00	5.71	23.40	4.77	25.17	8.91	24.36	7.05
6.	Moderate-Intensity Physical Activity (minutes/day)	51.80	25.59	64.67	23.33	58.82	24.07	46.00	16.17	67.83	35.09	57.91	29.16
7.	Systolic Blood Pressure (mmHg)	116.80	15.16	124.50	12.33	121.00	13.56	124.40	5.13	125.83	17.43	125.18	12.77
8.	Diastolic Blood Pressure (mmHg)	81.00	8.69	73.67	10.39	77.00	9.84	86.80	6.26	80.83	9.93	83.55	5.63
9.	Body Mass Index	25.68	.84	24.53	6.78	25.05	5.47	25.04	4.31	25.07	6.97	25.06	5.63
10.	Waist-Hip Ratio	.84	.09	.87	.06	.85	.07	.84	.09	.84	.05	.84	.07
11.	Waist Circumference (in.)	35.30	5.93	34.17	4.12	34.68	4.79	34.10	34.18	34.00	4.59	34.05	4.92
12.	Chair Stand Test (# in 30 seconds)	13.60	2.41	14.00	1.90	13.82	2.04	14.00	3.32	16.33	4.63	15.27	4.08
13.	Arm Curl Test (# in 30 seconds)	19.20	4.49	20.17	6.43	19.73	5.39	21.80	5.22	24.17	7.47	23.09	6.35
14.	2-Minute Step (# in 2 minutes)	102.40	16.92	95.50	36.33	98.64	28.06	108.80	16.93	123.50	20.11	116.82	19.39
15.	Sit-and-Reach (inches)	-.50	4.92	2.63	2.44	1.21	3.92	2.30	1.26	4.68	1.82	3.60	1.96
16.	Back Scratch (inches)	-1.30	3.39	.00	3.24	-.59	3.21	-.90	4.22	-1.25	2.95	-.48	3.41
17.	8-Foot Up-and-Go (seconds)	5.29	.65	5.43	.69	5.37	.64	4.75	.91	5.10	.60	4.94	.74

Table 16

Gain Scores for Theoretical Mechanisms and Outcomes of the Yoga for HEART Intervention

		Intervention (n = 5)		Control (n = 6)		Total (N = 11)	
	Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*
1.	Self-Efficacy Total	.20	.45	.00	.89	.09	.70
2.	Outcome Expectancy Total	-.20	.45	.00	.63	-.09	.54
3.	Index of Readiness Total	.60	3.58	-.83	6.05	-.18	4.90
4.	Index of Self-Regulation Total	7.60	3.71	1.67	7.42	4.36	6.53
5.	Social Support for Exercise Scale Total	-1.80	4.71	-5.17	6.71	-3.64	5.87
6.	Moderate Physical Activity (min/day)	-5.80	27.77	3.17	17.62	-.91	22.04
7.	Systolic Blood Pressure (mmHg)	7.60	17.01	1.33	11.25	4.18	13.78
8.	Diastolic Blood Pressure (mmHg)	5.80	10.50	7.17	14.37	6.55	12.16
9.	Body Mass Index (BMI)	-.64	.89	.55	.48	.01	.90
10.	Waist-Hip Ratio (WHR)	.00	.07	-.03	.05	-.01	.06
11.	Waist Circumference (inches)	-1.2	2.08	-.17	2.09	-.63	2.05
12.	Chair Stand Test (# in 30 seconds)	.40	3.05	2.33	4.23	1.45	3.70
13.	Arm Curl Test (# in 30 seconds)	2.60	2.41	4.00	3.90	3.36	3.23
14.	2-Minute Step Test (# in 2 min)	6.40	13.30	28.00	36.90	18.18	29.64
15.	Sit-and-Reach Test (inches)	2.80	4.01	2.06	2.70	2.40	3.20
16.	Back Scratch Test (inches)	.40	1.64	1.04	2.57	.75	2.12
17.	8-Foot Up-and-Go Test (seconds)	-.54	.41	-.33	.31	-.43	.36

Theoretical Mechanisms of Change

Behavioral change processes. Behavioral change process variables included self-knowledge, motivation appraisal, and self-regulation.

Self-knowledge. Self-knowledge was assessed with the SKI, using three open-ended questions and two Likert-type items to measure the constructs of self-efficacy and outcome expectancy. Three open-ended questions were used to elicit individual health concerns, plans, and goals at baseline (T1) and 12 weeks (T2). Narrative responses from participants in the Intervention and Active Control groups are summarized below.

All five participants in the Yoga for HEART Intervention group were able to identify at least one health issue of concern, with responses representing multiple

domains of wellness. Three participants were concerned with losing weight and two participants were interested in lowering their blood pressure. Two participants had osteoarthritis and were concerned with increasing strength and flexibility. One participant had osteoporosis and was interested in building bone strength. One individual was concerned with fatigue and was interested in improving their energy levels. One participant was interested in learning to relax more fully, breathe more deeply, and sleep more soundly. One individual was concerned with tending to their emotional health needs.

All five participants in the Intervention group had plans to achieve their health goals that included engaging in regular physical activity and eating a healthier diet. Plans for increasing physical activity included walking (100%), practicing yoga (80%), doing Pilates (40%), stretching (20%), playing tennis (10%), lifting weights (10%), using a stationary bike (10%), and joining an exercise class (10%). Other strategies to improve health included breathing, relaxation, counseling, being socially active, and getting adequate sleep.

All six participants in the Active Control group were able to identify at least one health issue. Three participants were concerned with losing weight and one participant was interested in lowering their blood pressure. Two individuals were concerned with strength, one was concerned with balance, and one was concerned with flexibility. Two participants were interested in managing pain and stiffness associated with osteoarthritis. One individual was concerned with fatigue and another was concerned with anxiety and depression.

All six participants in the Active Control group had plans to increase their physical activity using strategies such as walking (50%), hiking (17%), stretching (33%), yoga (100%), Pilates (50%), lifting weights (33%), using a stationary bike (33%), joining an exercise class (17%), and going to the gym (33%). Other strategies to improve health included breathing, relaxation, meditation, prayer, Bible reading, being socially active, eating a healthy diet, and getting proper sleep.

At baseline, one participant from the Intervention group and one participant from the Active Control group identified walking as a strategy to improve health. Following the intervention, 100% of participants in the Intervention group described walking as part of their plans to achieve their goals; in comparison, 50% of participants in the Active Control group listed walking as a strategy for improving health. Following the intervention, Yoga for HEART participants were able to make specific health plans and goals, such as "walk 3 miles per day," and "lose 20 pounds by January," compared to vague statements made by Active Control group participants, such as "exercise more" and "lose weight."

Self-efficacy. Self-efficacy was measured with a Likert-type item (1 – 3 scale). Self-efficacy data had a non-normal distribution ($p = .00$), with skewness of -.21 ($SE = .66$) and kurtosis of -2.44 ($SE = 1.28$) at T1 and skewness of .21 ($SE = .66$) and kurtosis of -2.44 ($SE = 1.28$) at T2. At baseline, 40% of participants in the Intervention group felt "sure" in their ability to enact their plans for physical activity and health behavior change; 60% percent of participants responded "maybe." At 12 weeks, the proportion of participants who felt "sure" in their ability to enact their health plans increased to 60%, and the proportion who responded "maybe" decreased to 40%. In comparison, 50% of

participants in the Active Control group felt "sure" in their ability to increase their physical activity and improve their health, and 50% responded "maybe" at T1 and T2; no change was observed in self-efficacy over time (Figure 6). The increase in self-efficacy among participants in the Intervention group was not statistically significant (M = .20, SD = .45). An ANCOVA with self-efficacy at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = .10, p = .76, η_p^2 = .012, or baseline self-efficacy, F (1, 10) = .10, p = .76, η_p^2 = .012.

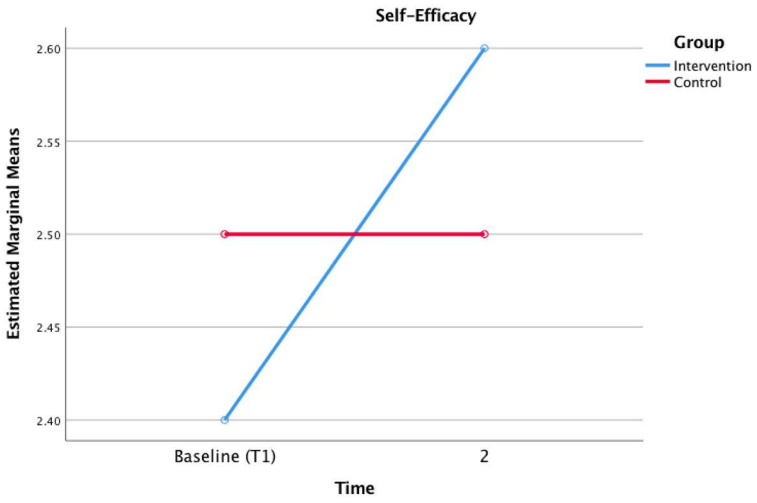

Figure 6. Effect of the Yoga for HEART Intervention on self-efficacy.

Outcome expectancy. Outcome expectancy was measured with one Likert-type item (1 – 3 scale). Outcome expectancy data had a non-normal distribution (p = .00), with skewness of -1.92 (SE = .66) and kurtosis of 2.04 (SE = 1.28) at T1 and skewness of 1.19 (SE = .66) and kurtosis of -.76 (SE = 1.28) at T2. At baseline, 100% of participants in the Intervention group reported it was "likely" they would achieve their health goals; at 12 weeks, 80% of participants felt they were "likely" to achieve their goals, and 20%

responded "maybe." Among participants in the Active Control group, 67% reported they were "likely" to achieve their health goals, and 33% responded "maybe," at T1 and T2; no change was observed in outcome expectancy over time (Figure 7). The change in outcome expectancy among participants in the Intervention group was not statistically significant (M = -.20, SD = .45). An ANCOVA with self-efficacy at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = .02, p = .89, η_p^2 = .003, or baseline outcome expectancy, F (1, 10) = .33, p = .58, η_p^2 = .038.

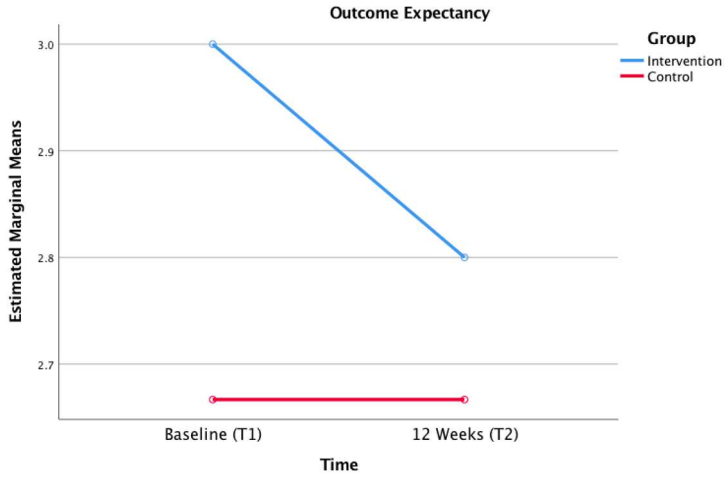

Figure 7. Effect of the Yoga for HEART Intervention on outcome expectancy.

Motivation appraisal. Motivation appraisal was measured with the IR. Motivation appraisal increased among Intervention group participants (M = .60, SD = 3.58) and decreased among Active Control group participants (M = .83, SD = 6.05) from baseline to 12 weeks, although changes did not reach statistical significance (Figure 8). An ANCOVA with motivation appraisal at T1 as the covariate revealed no significant

main effect of treatment group, F (1, 10) = .10, p = .76, η_p^2 = .012, or baseline motivation appraisal, F (1, 10) = .10, p = .76, η_p^2 = .012.

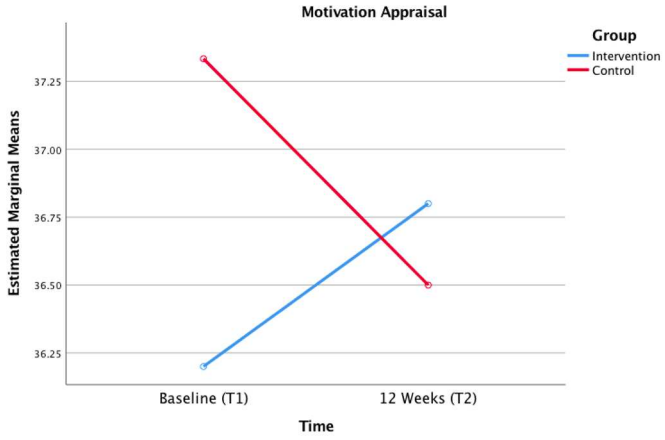

Figure 8. Effect of the Yoga for HEART Intervention on motivation appraisal.

Self-regulation. Self-regulation was measured with the ISR. A repeated measures ANOVA revealed a significant increase in self-regulation among participants in both groups F (1, 9) = 6.38, p = .03. Participants in the Intervention group demonstrated a greater increase in self-regulation (M = 7.60, SD = 3.71) when compared to participants in the Active Control group (M = 1.67, SD = 7.42; Figure 9). An ANCOVA with self-regulation at T1 as the covariate revealed a significant main effect of baseline self-regulation, F (1, 10) = .6.53, p = .03, η_p^2 = .427. There was no significant main effect of treatment group, F (1, 10) = .70, p = .43, η_p^2 = .048.

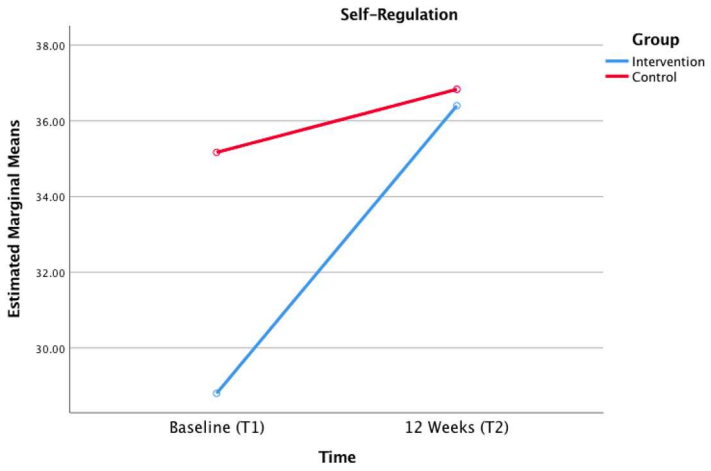

Figure 9. Effect of the Yoga for HEART Intervention on self-regulation.

Social contextual resources. Social contextual resources included social support and environmental resources for physical activity.

Social support. Social support for physical activity from family and friends was measured using the SSES. From baseline to 12 weeks, participants in both groups perceived a decrease in social support; this decrease was greater among Active Control group participants (M = -5.17, SD = 6.71) compared to Intervention group participants (M = -.18, SD = 4.71); change in social support was not statistically significant (Figure 10). An ANCOVA with social support at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = .36, p = .56, η_p^2 = .028, or baseline social support, F (1, 10) = 4.70, p = .06, η_p^2 = .364.

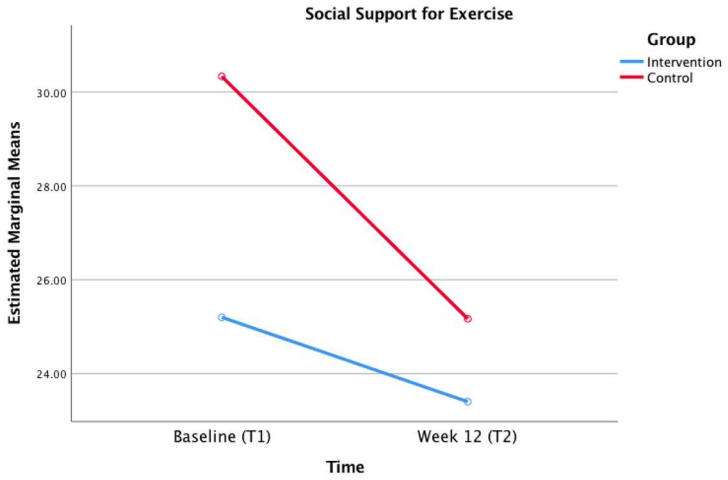

Figure 10. Effect of the Yoga for HEART Intervention on social support for exercise.

Environmental resources. Awareness and use of community and environmental resources among Intervention and Active Control group participants were observed descriptively. At baseline, all five participants in the Intervention group were able to identify between one and five community resources for physical activity, including the senior center (80%), nature trails (60%), gyms (60%), beaches (40%), pools (20%), yoga studios (20%), tennis courts (20%), fitness classes (20%), meet ups (20%), kayaking (20%), and paddle boarding (20%). At 12 weeks, all five Intervention group participants reported an increased use of community and environmental resources. For example, one participant increased her beach walks from once or twice per month (T1) to once or twice per week (T2). Two participants began meeting for nature walks once or twice per week outside of intervention sessions.

At baseline, four of the six participants in the control group were able to identify one or two community resources for physical activity, including the senior center (17%), beaches (17%), parks (17%), tai chi (17%), and Sierra Club (17%). At 12 weeks, all six

participants identified between one and three community resources for physical activity and two participants increased their use of resources. One participant increased their use of the senior center from once per week (T1) to twice per week (T2); another individual began walking their dogs in the park on a daily basis.

Outcome Variables

Physical activity health behavior. Daily time spent in moderate-intensity physical activity was measured with the ActiGraph accelerometer. Average daily minutes spent in moderate-intensity physical activity decreased among participants in the Intervention group (M = -5.80, SD = 27.77) and increased among participants in the Active Control group (M = 3.17, SD = 17.62), although these changes were not statistically significant (Figure 11). An ANCOVA with moderate-intensity physical activity at T1 entered as the covariate detected a significant interaction between treatment group and baseline physical activity, F (1, 7) = 6.35, p = .04, η_p^2 = .239. A significant main effect was detected of baseline physical activity, F (1, 7) = 8.84, p = .02, η_p^2 = .333, but not treatment group, F (1, 7) = 3.77, p = .09, η_p^2 = .142.

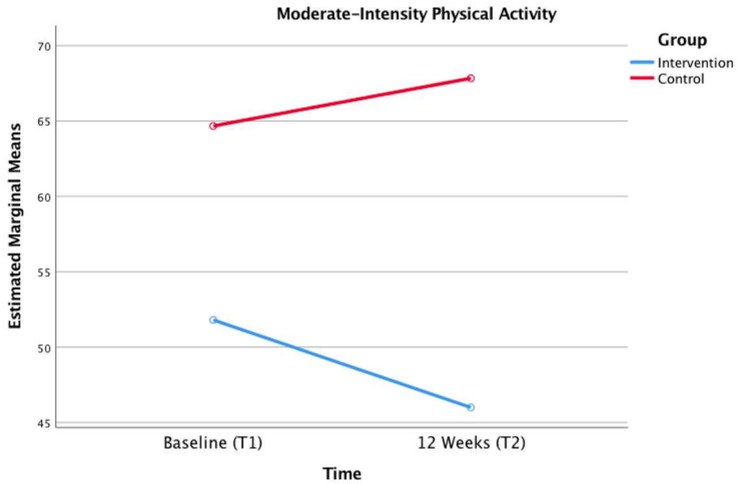

Figure 11. Effect of the Yoga for HEART Intervention on moderate-intensity physical activity.

Cardiovascular health outcomes. Cardiovascular health outcomes included BP, BMI, and body composition (i.e., WHR and waist circumference).

Blood pressure. Systolic blood pressure (SBP) was measured with an automated sphygmomanometer. Systolic BP increased among participants in the Intervention group ($M = 7.60$, $SD = 17.01$) and in the Active Control group ($M = 1.33$, $SD = 11.25$); change was not statistically significant (Figure 12). An ANCOVA with systolic BP at T1 as the covariate revealed no significant main effect of treatment group, $F\ (1, 10) = .06$, $p = .81$, $\eta_p^2 = .006$, or baseline systolic BP, $F\ (1, 10) = 2.12$, $p = .18$, $\eta_p^2 = .209$.

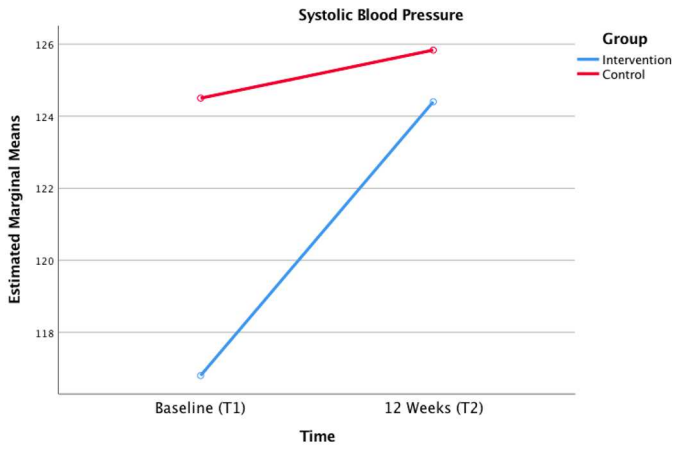

Figure 12. Effect of the Yoga for HEART Intervention on systolic blood pressure.

Diastolic blood pressure (DBP) was measured with an automated sphygmomanometer. Diastolic BP increased among participants in the Intervention group ($M = 7.60$, SD = 17.01) and in the Active Control group ($M = 7.17$, $SD = 14.37$);

change was not statistically significant (Figure 13). An ANCOVA with diastolic BP at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = .66, p = .44, η_p^2 = .070, or baseline diastolic BP, F (1, 10) = .51, p = .50, η_p^2 = .053.

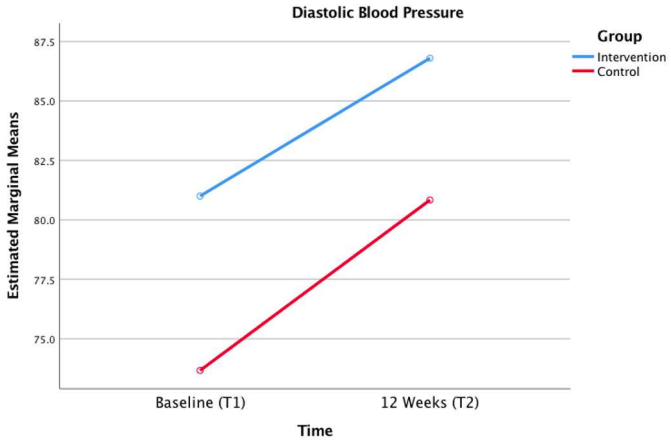

Figure 13. Effect of the Yoga for HEART Intervention on diastolic blood pressure.

Body mass index. Body mass index (BMI) was calculated as a function of participant height and weight (kg/m^2). Body mass index data had a non-normal distribution at baseline (p = .02) and 12 weeks (p = .01), with skewness of 1.57 (SE = .66) and kurtosis of 2.16 (SE = 1.28) at T1 and skewness of 1.69 (SE = .66) and kurtosis of 2.58 (SE = 1.28) at T2. Following log transformation, BMI data had a normal distribution at T1 (p = .08) and T2 (p = .06) with skewness of 1.22 to 1.36 (SE = .66) and kurtosis of 1.17 to 1.52 (SE = 1.28). Body mass index decreased among participants in the Intervention group (M = -.64, SD = .89) and increased among participants in the Active Control group (M = .55, SD = .58; Figure 14). An ANCOVA with BMI at T1 as the covariate revealed a significant main effect of treatment group, F (1, 10) = 7.91, p = .02, η_p^2 = .013, and baseline BMI, F (1, 10) = 617.12, p = .00, η_p^2 = .987. The main

effects of treatment group and BMI at T1 remained significant with the log transformation entered into the analysis (i.e., treatment group, F (1, 10) = 7.33, p = .03, η_p^2 = .015, and BMI at T1, F (1, 10) = 450.35, p = .00, η_p^2 = .980).

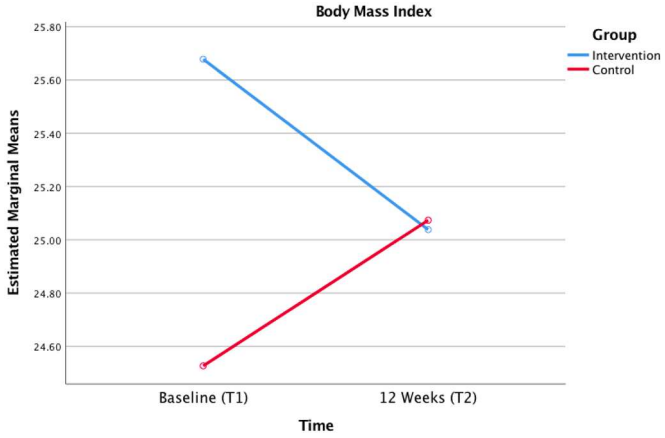

Figure 14. Effect of Yoga for HEART Intervention on body mass index.

Body composition. Waist-hip ratio (WHR) was computed as a function of waist and hip circumference. Waist-hip ratio was unchanged among participants in Intervention group (M = .00, SD = .07) and decreased among participants in the Active Control group (M = -.03, SD = .05); change was not statistically significant (Figure 15). An ANCOVA with WHR at T1 as the covariate revealed a significant main effect of baseline WHR, F (1, 10) = 5.39, p = .05, η_p^2 = .040. The main effect of treatment group was not significant, F (1, 10) = .23, p = .65, η_p^2 = .022.

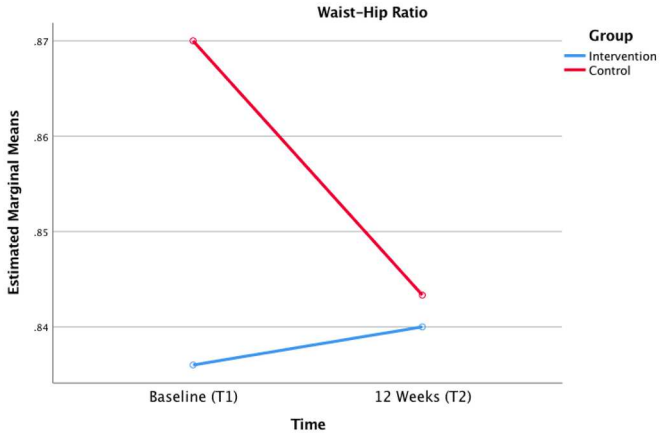

Figure 15. Effect of the Yoga for HEART Intervention on waist-hip ratio.

Waist circumference was measured with a tape measure. Participants in the Intervention group decreased their mean waist circumference by 1.20 inches (*SD* = 2.08), compared to participants in the Active Control group, who decreased their mean waist circumference by .17 inches (*SD* = 2.09); change was not statistically significant (Figure 16). An ANCOVA with waist circumference at T1 as the covariate revealed a significant main effect of baseline waist circumference, F (1, 10) = 42.17, p = .00, η_p^2 = .840. The main effect of treatment group was not significant, F (1, 10) = .53, p = .49, η_p^2 = .011.

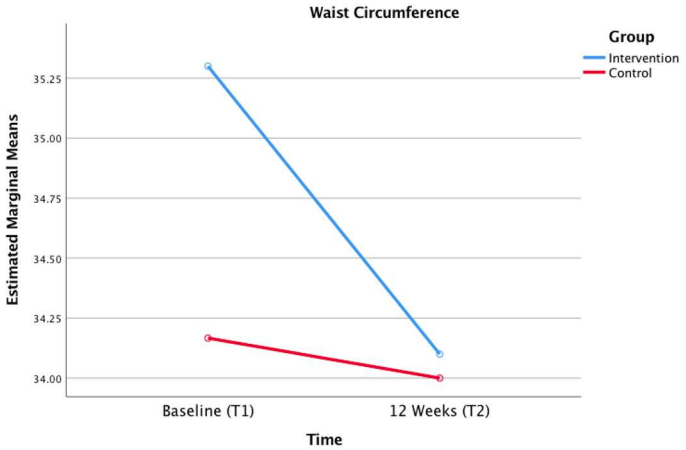

Figure 16. Effect of the Yoga for HEART Intervention on waist circumference.

Functional fitness outcomes. Functional fitness outcomes included endurance, strength, balance, and flexibility as measured by the Senior Fitness Test (SFT).

Aerobic endurance. The 2-minute step test was used to measure aerobic endurance. Aerobic endurance increased among Intervention group participants (M = 6.40, SD = 13.30) and Active Control group participants (M = 28.00, SD = 36.90); change was not statistically significant (Figure 17). An ANCOVA with aerobic endurance at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = 2.02, p = .19, η_p^2 = .188, or baseline aerobic endurance, F (1, 10) = 1.07, p = .33, η_p^2 = .099.

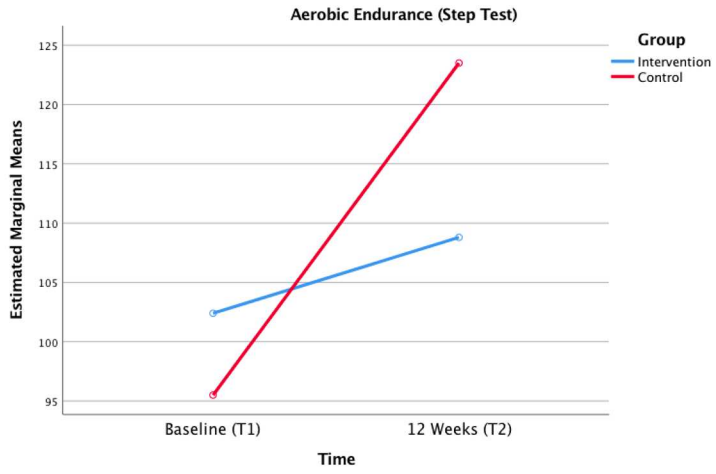

Figure 17. Effect of the Yoga for HEART Intervention on aerobic endurance.

Lower body strength. The chair stand test was used to measure lower body strength. A repeated measures ANOVA detected significant improvements in lower body strength among participants in both groups, F (1, 9), p = .01. Chair stand test scores

increased significantly among participants in the Intervention group (M =.40, SD = 3.05) and in the Active Control group (M = 2.33, SD = 4.23; Figure 18). An ANCOVA with lower body strength at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = .70, p = .43, η_p^2 = .066, or baseline lower body strength, F (1, 10) = 1.69, p = .23, η_p^2 = .159.

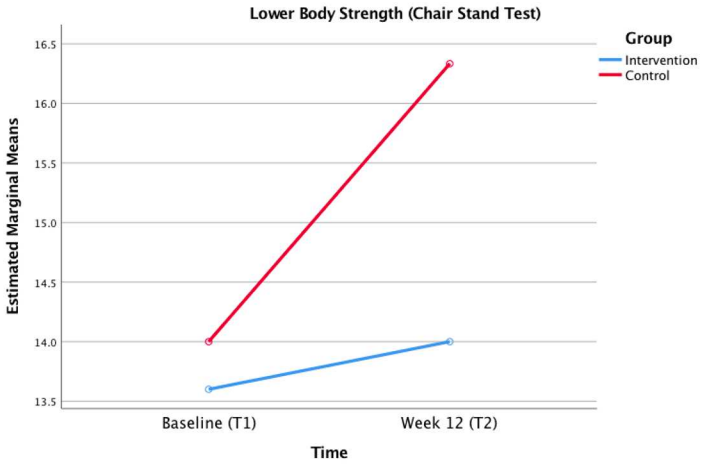

Figure 18. Effect of the Yoga for HEART Intervention on lower body strength.

Upper body strength. The arm curl test was used to measure upper body strength. A repeated measures ANOVA detected a significant increase in upper body strength among participants in both groups, F (1, 9), p = .01. Arm curl test scores increased significantly among participants in the Intervention group (M = 2.60, SD = 2.41) and in the Active Control group (M = 4.00, SD = 3.9; Figure 19). An ANCOVA with upper body strength at T1 as the covariate revealed a significant main effect of baseline upper body strength, F (1, 10) = 23.26, p = .00, η_p^2 = .716. The main effect of treatment group was not significant, F (1, 10) = .43, p = .53, η_p^2 = .013.

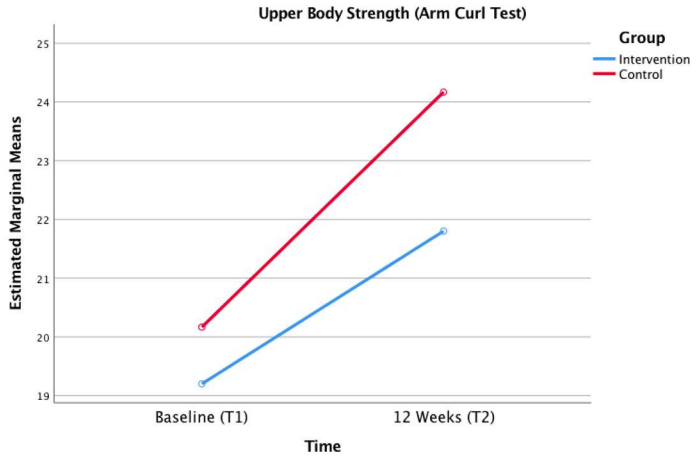

Figure 19. Effect of the Yoga for HEART Intervention on upper body strength.

Lower body flexibility. The sit-and-reach test was used to measure lower body flexibility. A repeated measures ANOVA detected a significant increase in lower body flexibility among participants in both groups, F (1, 9), p =. 04. Sit-and-reach test scores improved significantly among participants in the Intervention group (M = 2.80, SD = 4.01) and in the Active Control group (M = 2.06, SD = 2.70; Figure 20). An ANCOVA with lower body flexibility at T1 as the covariate revealed no significant main effect of treatment group, F (1, 10) = 3.14, p = .11, η_p^2 = .186, or baseline lower body flexibility, F (1, 10) = 2.07, p = .19, η_p^2 = .123.

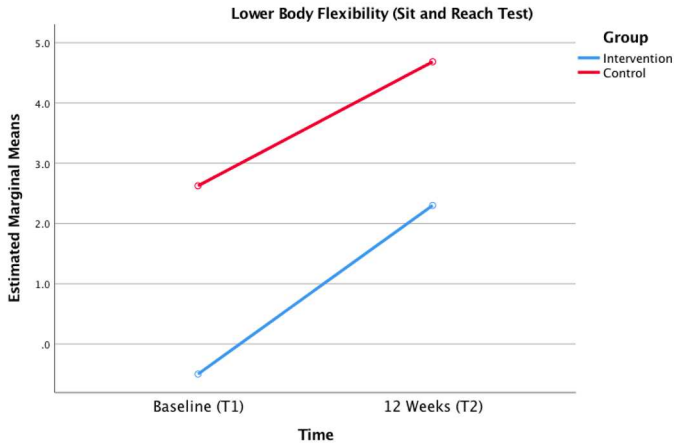

Figure 20. Effect of the Yoga for HEART Intervention on lower body flexibility.

Upper body flexibility. Upper body flexibility was measured using the back scratch test; data had a non-normal distribution at T1 (p = .01) with skewness of -.21 (*SE* = .66) and kurtosis of -2.18 (*SE* = 1.28). Log transformation of back scratch test data did not result in a normal distribution; original values were entered into the analysis. Upper body flexibility increased among participants in the Intervention group (M = .40, SD = 1.64) and in the Active Control group (M = 1.04, SD = 2.57); change was not statistically significant (Figure 21). An ANCOVA with upper body flexibility at T1 as the covariate revealed a significant main effect of baseline upper body flexibility, F (1, 10) = 13.47, p = .01, η_p^2 = .619. The main effect of treatment group was not significant, F (1, 10) = .22, p = .65, η_p^2 = .010.

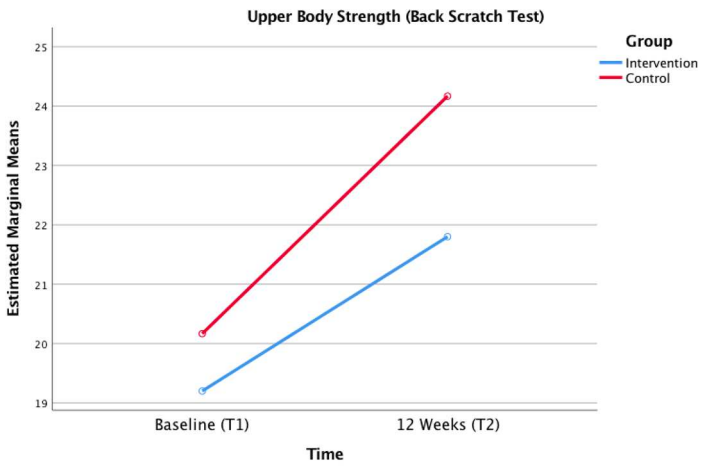

Figure 21. Effect of the Yoga for HEART Intervention on upper body flexibility.

Dynamic balance. The 8-foot up-and-go test was used to measure dynamic balance. A repeated measures ANOVA detected a significant improvement in dynamic balance among participants in both groups, F (1, 9), p = .00. Timed up-and-go test scores improved significantly among participants in the Intervention group (M = -.54, SD = .41) and in the Active Control group (M = -.33, SD = .31; Figure 22). An ANCOVA with dynamic balance at T1 as the covariate revealed a significant main effect of baseline dynamic balance, F (1, 10) = 26.89, p = .00, η_p^2 = .724. The main effect of treatment group was not significant, F (1, 10) = .86, p = .38, η_p^2 = .023.

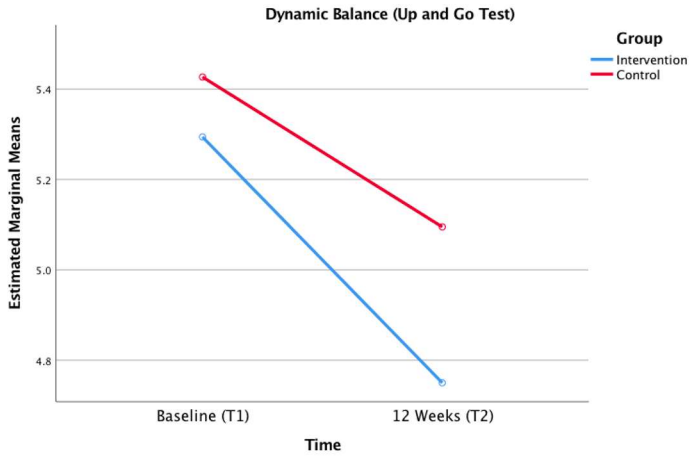

Figure 22. Effect of the Yoga for HEART Intervention on dynamic balance.

Summary

Study findings supported the feasibility (i.e., acceptability, demand, implementation fidelity, and efficacy) of the Yoga for HEART Intervention in community-dwelling older adults at risk for CVD. Acceptability surveys supported the intervention as acceptable. There was a demand for the intervention supported by low attrition and good attendance. Implementation fidelity was supported using interventionist and external review of intervention sessions. Results of one-way ANCOVA using marginal models to evaluate changes in social contextual resources, behavioral change processes, and health outcomes as a function of time, treatment group, and time by group interactions, indicated that BMI significantly improved among Intervention group participants when compared to Active Control group participants. Participants in the Intervention group increased behavioral change processes, including self-efficacy, motivation appraisal, and self-regulation, when compared to participants in the Active Control group. Participants in the Intervention group achieved an increase in self-knowledge, as they reported more specific health goals and plans from baseline to 12

weeks when compared to Active Control group participants. Participants in the Intervention group also realized an increase in social contextual resources, as they were able to identify and use a greater number of community and environmental resources for physical activity from T1 to T2 when compared to Active Control group participants. Results from repeated measured ANCOVA indicated that participants in both Intervention and Active Control groups showed significant improvement across a range of health outcomes, including strength, flexibility, and balance. Findings also support the safety of the Yoga for HEART Intervention, as no adverse events were reported.

Chapter 5

DISCUSSION

This feasibility study evaluated the acceptability, demand, implementation fidelity, and efficacy of the Yoga for HEART (Health Empowerment and Realizing Transformation) Intervention among community-dwelling older adults at risk for cardiovascular disease (CVD). This research examined the effects of the intervention on theoretical mechanisms of change (i.e., social contextual resources and behavioral change processes) and outcomes tested (i.e., physical activity behavior, cardiovascular health, and functional fitness). Research findings have implications for theory, nursing science, future research, and practice. Chapter 5 presents research findings within the context of cardiovascular health promotion and gerontological nursing, consistent with the Specific Aims of the study. Chapter 5 addresses research strengths, limitations, and implications for nursing theory, research, and practice.

Specific Aim 1

Acceptability. The Yoga for HEART Intervention was evaluated as acceptable by the community-dwelling older adults enrolled in this study. Based on participant evaluation and interventionist field notes, the content of the 12-week intervention was very acceptable. Acceptability findings in this study are similar to those reported in other Wellness Motivation Theory-based intervention studies. McMahon (2012) and Perez (2009) reported excellent acceptance of physical activity interventions based on Wellness Motivation Theory (WMT) among older adults from diverse backgrounds, including rural-dwelling older adults at risk for falls and Hispanic older women at risk for CVD. While acceptability has not been systematically reported in yoga interventions, it is an

important element to evaluate in research and practice (Barrows & Fleury, 2016). Understanding participant acceptance of an intervention (e.g., to what extent it is suitable and satisfying) is critical for intervention development, testing, sustainability, and translation to practice (Bowen et al., 2009; Sidani & Braden, 2011).

The acceptability of the Yoga for HEART Intervention may be influenced by: (a) offering an intervention that was meaningful and relevant to older adults; (b) use of research and theory to guide recruitment, intervention delivery, and retention; and (c) integrating the perspectives and preferences of community members into the research protocol.

A majority of older adults, whether physically or active not, have a positive attitude towards physical activity and recognize its important role in promoting health. Systematic reviews of physical activity motivators and barriers in older adults have indicated that health concerns are the most prominent factor influencing participation in physical activity (Baert, Gorus, Mets, Geerts, & Bautmans, 2011; Costello, Kafchinski, Vrazel, & Sullivan, 2011). Many older adults are interested in practicing yoga to improve their health, but are unsure if yoga is appropriate or how to start (Yoga Alliance, 2016). Other factors influencing motivation for physical activity in older adults include social support, self-efficacy, outcome expectancy, environmental characteristics, accessibility of programs and facilities, and barriers such as lack of time and fear of injury (Baert et al., 2011; Costello et al., 2011). Older adults are more likely to participate in physical activity programs that focus attention on their individual needs and preferences, and they have an interest in programs that help them set personal goals, monitor their progress, and overcome barriers to being active (Bethancourt, Rosenberg,

Beatty, & Arterburn, 2014; Chong et al., 2012). For many older adults, social interaction and a sense of community are important motivators to engage in physical activity and attend group-based programs, including yoga (Bethancourt et al., 2014; Wertman, Wister, & Mitchell, 2016). Older adults with limited economic resources are more likely to use programs and facilities that are inexpensive or free (Bethancourt et al., 2014, Chong et al., 2012; Wertman et al., 2016).

The critical inputs of the Yoga for HEART Intervention (i.e., empowering education, social network support, and motivational support) were designed to promote physical activity in older adults through the theoretical mechanisms of behavioral change processes and social contextual resources, including an increase in motivation, social support, self-regulation, self-efficacy, outcome expectancy, and environmental resources. An emphasis was placed on health and safety throughout the Yoga for HEART Intervention, including recruitment materials, critical content, and participant workbooks. The concept of *ahimsa* (non-harm) was used to guide each group session. Participants were encouraged to practice yoga at their own pace, without comparison to others, using modifications and props to adapt yoga postures to meet their individual needs. Yoga postures, breathing, and meditation were introduced at a beginner level and progressed gradually as participants gained confidence and ability over time. Intervention sessions included time for group discussion to identify and create personal, social, and community resources for physical activity. Group discussion included the development of knowledge and skills to discover strengths, establish goals, monitor progress, gather social support, and enact strategies to overcome barriers to health behavior change.

Research conducted by Notthoff and colleagues (2016) found that older adults felt motivated to participate in physical activity programs that were paired with positively framed messages emphasizing the benefits of being active, as compared to negatively framed messages focusing on the consequences of not participating in physical activity. Messaging strategies used in the Yoga for HEART Intervention were positively framed, with an emphasis on wellness and individual strengths. Recruitment materials described the research as "a pilot study to explore the health benefits of yoga in older adults" and "a 12-week program designed to help older adults meet their health and fitness goals." Each intervention session focused attention on the identification and development of individual and community strengths and resources for physical activity and health behavior change.

The design, implementation, and evaluation of the Yoga for HEART Intervention was guided by recommendations from community members, leaders, and experts in gerontological nursing, community-based research, theory-based intervention, physical activity, and yoga therapy. This study incorporated principles of community-based research, as the intervention was delivered in a community setting and involved members of the community in decision-making processes throughout the course of the study (Israel, Eng, Schulz, & Parker, 2013; Minkler & Wallerstein, 2008). Older adults and leaders in the community were consulted about the design and methods of the research, the dose and setting of the intervention, the treatment condition of the control group, the content of the participant workbook, and the selection of health outcomes and measures. The yoga postures, breathing exercises, and meditation practices included in this study were tested with older adults across a range of community-based settings (Greendale et al., 2012; Krucoff, Carson, Peterson, Shipp, & Krucoff, 2010; Wang et al., 2013).

Demand. In this feasibility study, demand for the intervention was good as evidenced by low attrition rates (27%) and good attendance rates (63%) compared to those reported in the literature. Attrition rates of yoga interventions in older adults have ranged from zero percent in a sample of adults with type 2 diabetes (Gordon et al., 2008) to 29% in a sample of adults with chronic obstructive pulmonary disease (Donesky-Cuenco et al., 2009). Yoga session attendance ranged from 50% among community-dwelling adults with type 2 diabetes (Skoro-Kondza et al., 2009) to 95% among older adults with dementia living in a long-term care facility (Fan & Chen, 2011). Participants in this study missed group sessions for various personal reasons related to their own health, as well as the well-being of others. Many participants were caring for family members with a range of health conditions, and placed the needs of others above their own, even if that meant missing a session. Attrition in this study was due to caregiving responsibilities, scheduling conflicts, and elective surgery. Reasons for attrition were consistent with findings from a review of the literature (Barrows & Fleury, 2016). In the future, offering a wider range of options to attend intervention sessions during different days and times throughout the week could minimize attrition and promote attendance.

Implementation Fidelity. The Yoga for HEART Intervention was delivered as planned. The manualized intervention, including lists of standard supplies and equipment for each group session, ensured the interventionist and site were well-prepared. Fidelity to intervention delivery, receipt, and enactment were evaluated through the Index of Procedural Consistency, external review, and field notes. The interventionist met with the research team on a regular basis to review the delivery of critical inputs and to minimize drift from the protocol. Continuing to refine fidelity monitoring will facilitate

replication of the Yoga for HEART Intervention and provide a foundation for quality improvement monitoring when the program is translated to practice. Understanding implementation fidelity improves the ability to replicate interventions and to reach valid conclusions on their effects (Bellg et al., 2004; Gearing et al., 2011; Ibrahim & Sidani, 2015).

Specific Aim 2

Theoretical mechanisms of change.

Behavioral change processes. Behavioral change processes in WMT include self-knowledge, motivation appraisal, and self-regulation. Behavioral change processes reflect the propensity to strive toward new goals and move beyond goals that have been achieved (Fleury, 1991, 1996).

Self-knowledge. Self-knowledge was measured using the Self-Knowledge Inventory (SKI). Three open-ended questions were designed to elicit individual goals, plans, and strategies related to physical activity and health behavior change. Two Likert-type items were used to assess self-efficacy and outcome expectancy within the key construct of self-knowledge. Self-efficacy, or an individual's confidence in their ability to engage in a specific behavior, increased among participants in the Intervention group when compared to participants in the Active Control group, although the differences within and between groups were not significant. Participants described a range of personal health goals representing physical, mental, social, and spiritual dimensions of wellness. Most participants were confident in their ability to engage in physical activity, but needed support in specifying goals, clarifying plans, and enacting strategies for health behavior. Despite having multiple chronic health conditions (e.g., hypertension and

osteoarthritis), participants demonstrated a positive attitude toward physical activity and viewed themselves as active and healthy, with an openness to new ideas and a willingness to try new things. These findings are consistent with the theoretical perspective of the Yoga for HEART Intervention, recognizing older adults as dynamic and complex individuals with inherent potential for positive growth and change.

The concept of self-knowledge is central to motivation for health behavior change, as it provides a context of meaning through which individuals acknowledge hopes and fears about the future (Fleury & Sedikides, 2007). Self-knowledge evaluated with the SKI assessed self-relevant goals and intentions to increase awareness and understanding of participant values, goals, plans, efficacy, and expectations for health behavior change. This understanding allows the interventionist to facilitate contextually relevant change by addressing representational processes (e.g., future possible selves), evaluative processes (e.g., self-efficacy), and behavioral action (e.g., self-regulation; Fleury & Sedikides, 2007).

Motivation appraisal. Motivation appraisal as measured with the Index of Readiness (IR) increased among participants in the Intervention group and decreased among participants in the Active Control group, although differences within and between groups were not statistically significant. Most participants thought about what might happen if they didn't begin a program of physical activity, and they had considered new ways to integrate more physical activity into their lives. Many felt that they needed to make some changes, and they were willing to make sacrifices to participate in physical activity on a daily basis. However, participants were less likely to have a plan for being more active and were not well prepared with strategies to overcome barriers to physical

activity and health behavior change. Participants in the Intervention group increased their scores on IR items pertaining to goal commitment and identification of barriers, indicating that they were able to set goals for physical activity, create plans to achieve their goals, anticipate barriers to becoming more active, and develop strategies to overcome these barriers. Intervention group participants were encouraged to set SMART (i.e., specific, measureable, achievable, relevant, and timed) goals and to establish a plan for achieving their goals (Bovend'Eerdt, Botell, & Wade, 2009). During group discussion, participants adjusted and shaped their goals to better reflect their needs and priorities, which they noted were evolving constantly throughout the course of the study. For example, one participant in the Intervention group became a widow during the program, and this significant life event prompted her to reevaluate her values and goals related to health and wellness. She explained, "At first, when I joined this program, my goals were to become stronger and more flexible, physically. Well, things have changed since then. Now, I need to find a different type of strength and flexibility, with my mental health, and my emotional health."

Self-regulation. Self-regulation as measured with the Index of Self-Regulation (ISR) increased significantly in both Intervention and Active Control groups. Most participants realized the important role of physical activity in maintaining and improving their health. They reminded themselves of the good they were doing by participating in physical activity, and they watched for signs of improvement as they became more active. However, participants were less likely to monitor their physical activity or to document their progress to see if they were meeting their goals. Throughout the study, Intervention group participants were encouraged to maintain a physical activity log and to

keep a journal for self-reflection on their experiences with health behavior change. Group discussion at the end of each intervention session provided time for participants to share their perspectives, including their personal goals for health, plans to achieve their goals, and strategies they found helpful along the way. Several participants set goals for walking and began tracking their steps per day. They exchanged ideas on how to increase their number of daily steps, and they taught each other how to monitor their progress using mobile phone applications and portable electronic devices. Other participants were interested in reducing sedentary behavior, so they began tracking time spent using a computer or watching TV, and they shared ideas about breaking up sedentary bouts with intervals of light activity, including standing, stretching, walking, and yoga.

Self-regulation is a critical component of interventions designed to promote health behavior change (Bandura, 2005; McAuley et al., 2011; Park, Elavsky, & Koo, 2014). Bandura (2005) noted that health patterns are not changed through willpower alone, but through the psychosocial and behavioral processes of motivation and self-regulation. Self-regulation is essential to goal-directed behavior. Health behavior change, including the initiation and maintenance of regular physical activity, is inherently goal-directed; it does not rely on habitual responses, but instead involves the development and use of self-regulatory skills (Bandura, 1991, 2005). Research has shown that a dynamic relationship exists between physical activity, self-regulation, and other motivational processes, including self-efficacy, outcome expectancy, and social support (Ayotte, Margrett, & Hicks-Patrick, 2010; Dishman et al., 2005; Olson & McAuley, 2015). Interventions that

promote the use of self-regulation and other motivational strategies to support health behavior change should be integral to research and practice in this field.

Participants in this study reported relatively high levels of behavioral change processes at baseline, including self-efficacy (e.g., *m* = 2.45 on a scale from 1 to 3), outcome expectancy (e.g., *m* = 2.82 on a scale from 1 to 3), motivation appraisal (e.g., *m* = 36.82 on a scale from 9 to 45) and self-regulation (e.g., *m* = 32.27 on a scale from 9 to 45). Participants enrolled in the study feeling confident in their ability to engage in physical activity and achieve their health goals. They were motivated to be physically active and ready to make a commitment to health behavior change, which left little room for improvement on these theoretical mediating variables and may have created a ceiling effect. Despite elevated levels of reported confidence, readiness, and self-regulation, participants from both groups did not realize a significant increase in physical activity from baseline to 12 weeks, indicating that their perceptions of self-efficacy, outcome expectancy, motivation appraisal, and self-regulation were not enough to produce changes in health behavior. In this study, self-efficacy and outcome expectancy were each measured with one Likert-type item, which may have limited our assessment of these multidimensional concepts. Motivation appraisal and self-regulation were also measured with Likert scales, which have been shown to be more vulnerable to bias and confounding factors than visual analog scales, thereby contributing to ceiling effects (Voutilainen, Pitkaaho, Kvist, & Vehvilainen-Julkunen, 2015). Future research might select more sensitive instruments to measure the constructs of self-efficacy and outcome expectancy, and consider the use of visual analog scales instead of Likert scales to reduce the risk of bias, the influence of confounding factors, and the presence of ceiling effects.

Social contextual resources.

Social support. Social support measured with the Social Support for Exercise Survey (SSES) decreased in both Intervention and Active Control groups, although differences within and between groups were not statistically significant. Participants reported that friends and family members showed support by providing encouragement for physical activity, engaging in activity with them, and talking about how much they like to stay active. However, friends and family were unlikely to adjust their schedules to accommodate plans for physical activity. Eighty percent of participants in the Intervention group were informal caregivers to family members, and they needed extra support to be able to attend group sessions. One participant was caring for their spouse with dementia, another participant was caring for their adult child with special needs, and several participants were caring for young grandchildren. While the burden of caregiving experienced by participants may have had a negative influence on perceptions of social support, several participants were motivated by the desire to stay active and healthy, and to care for themselves so they could continue to care for others. Future yoga intervention research is needed to address the health concerns of family caregivers, who experience high levels of stress and related chronic health conditions (Danucalov, Kozasa, Alfonso, Galduroz, & Leite, 2015; Martin & Keats, 2014; Van Puymbroeck, Payne, & Hsieh, 2007).

While participants did not perceive an increase in social support for physical activity, they described a feeling of social connectedness, defined by O'Rourke and Sidani (2017) as the opposite of loneliness, a subjective evaluation of the extent to which one has meaningful, close, and constructive relationships with others. Social

connectedness includes: (a) caring about others and feeling cared about by others, and (b) feeling of belonging to a group or community. One study found that social connectedness has the potential to influences older adults' health and well-being more than social support (Ashida & Heaney, 2008). Additional research is needed to identify strategies to enhance social connectedness and decrease loneliness among underactive older adults at risk for CVD. Developing an understanding of the meaning and determinants of social connectedness is essential to inform the design and selection of interventions to promote social connectedness and quality of life in older adults (O'Rourke & Sidani, 2017).

Environmental resources. Community and environmental resources for physical activity were measured with the Neighborhood Environment Questionnaire (NEQ). Participants in the Intervention group identified and used a greater number of community and environmental resources for physical activity when compared to participants in the Active Control group. Throughout the program, participants in the Intervention group were encouraged to explore a range of community resources for physical activity, including walking, attending other yoga classes, and trying different types of individual and group exercise. They were prompted to engage in a variety of activities offered at the senior center, including yoga, dance, tai chi, and stretching and strengthening classes. The Yoga for HEART workbook, provided to participants in the Intervention group, included a comprehensive list of resources for physical activity in the community. Throughout the program, participants suggested additional community resources for health behavior and brought in activity calendars from their local churches, community colleges, and recreation centers; these additional resources were added to the workbook.

Several participants in the Intervention group began walking on a regular basis, and some began meeting outside of yoga class for group walks along a local beach path. Others found it easy to walk in their neighborhoods or visit a nearby nature trail. Many participants shared that they were taking more walks with family members, including their pets. One woman noted that she and her dog were each losing weight as a result, which pleased both her physician and the veterinarian. Another participant began walking her grandchildren to school instead of driving them in the car; she explained how this helped her reach her new goal of taking 10,000 steps per day, remarking that "I'm chasing kids anyway, so I may as well get those steps in; it's a no-brainer to do them both at the same time." Another woman was able to integrate more physical activity into her daily routine by walking at the soccer field while her grandson attended practice. She described how she began keeping an extra pair of sneakers in her car along with his soccer cleats, so that she would be prepared for activity when the opportunity arose. Participants demonstrated the ability to "create space" in their lives by combining caregiving responsibilities with family-centered physical activities, enabling them to fulfill important family obligations and to accomplish personal goals for health.

Participants who attended Yoga for HEART Intervention sessions were able to identify and use a range of existing community resources for physical activity, including programs and services (e.g., group fitness classes and senior center activities) as well as environmental sources of support (e.g., beach paths, nature trails, and public parks). These findings are consistent with theory-based intervention research conducted by McMahon and colleagues (2018), showing older adults who received encouragement to increase their use of community resources had significantly greater odds of utilizing

community resources targeting physical activity and the prevention of falls. This study also supports walking as a meaningful source of activity for older adults, emphasizing the important role of the natural and built environments in shaping patterns of health behavior (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009; Haselwandter et al., 2015). Additional research is needed to better understand how environmental characteristics could promote successful aging, and calls for determining specific aspects of the environment that increase physical activity in older adults. Interventions encouraging the use of community programs (e.g., walking clubs) could be combined with strategies to increase environmental resources (e.g., installing park benches) to achieve a greater impact on public health.

Physical activity health behavior. Moderate-intensity physical activity as measured with the ActiGraph accelerometer did not increase significantly among participants in Intervention or Active Control groups. Similarly, participants in both groups did not demonstrate any change in light-intensity physical activity or sedentary bouts of behavior. During the screening and enrollment process, participants tended to underestimate the amount of time they spent in physical activity as measured subjectively with the Stages of Change Questionnaire (Marcus & Forsythe, 2009). Participants described themselves as underactive, defined as accumulating < 150 minutes of moderate-intensity physical activity per week. When baseline data was collected objectively using the ActiGraph accelerometer, participants engaged in adequate amounts of physical activity to promote cardiovascular and overall health. However, they were interested in increasing their activity levels to address other important health concerns, including hypertension and obesity, which are risk factors for CVD and other chronic

health conditions, such as type 2 diabetes. While experts recommend that older adults engage in at least 150 minutes of moderate-intensity physical activity per week to maintain and improve health, additional benefits may be realized by increasing the total amount of weekly activity up to 300 minutes (Nelson et al., 2007; USDHHS, 2008). Future research could explore the health benefits of yoga in older adults who engage in adequate levels of physical activity, yet remain at risk for CVD due to the presence of other health conditions. Interventions designed to reduce sedentary time also warrant further investigation, especially among older adults who frequently engage in sedentary activities, such as reading, watching TV, and using a computer.

Cardiovascular health. Cardiovascular health outcomes included blood pressure (BP), body mass index (BMI), and body composition.

Blood pressure. Systolic and diastolic BP did not change significantly among participants in Intervention and Active Control groups. In contrast with these findings, three recent meta-analyses of yoga for hypertension found preliminary evidence that yoga can reduce BP by clinically significant amounts (Cramer et al., 2014a, 2014b; Hagins et al., 2013). Despite variation in study methods, the meta-analyses found relatively similar findings, with reductions in SBP equivalent to 4.17, 9.65, and 5.85 mmHg, and reductions in DBP equivalent to 3.26, 7.22, and 4.12 mmHg (Cramer et al., 2014a, 2014b; Hagins et al., 2013). Although the effects of yoga on lowering BP are likely to be modest, a 2 mmHg reduction in DBP can reduce the risk of stroke by 14%, and a 10 mmHg decrease in SBP is associated with a 30% relative reduction in risk of stroke (Lewington, Clarke, Qizilbash, Pito, & Collins, 2002). Thus, small reductions in BP (e.g., 5 mmHg in SBP or 2 mmHg in DBP), achievable through yoga, can be expected to

significantly reduce the risk of CVD in older adults. One pathway by which yoga lowers BP is via reductions in stress due to increases in self-regulation and improvements in autonomic nervous system function (Gard, Noggle, Park, Vago, & Wilson; Innes & Vincent, 2007). Future research in this area should further explore the physiological and psychosocial mechanisms by which yoga interventions achieve desired effects, including the relative contributions of postures, breathing, and meditation to improvements in cardiovascular health outcomes.

In a systematic review and meta-analysis of yoga in reducing CVD risk, Cramer and colleagues (2014a, p. 180) noted that "exactly 12 weeks of intervention duration seems to be more effective than shorter or longer interventions." While the Yoga for HEART Intervention had a duration of 12 weeks, none of the participants attended 100% of group sessions, effectively reducing the dose of the intervention that was received. In the future, offering a wider selection of yoga classes to meet the flexible scheduling needs of community-dwelling older adults might improve attendance and increase the dose of the intervention that is actually delivered to participants.

Body mass index. Body mass index improved significantly among participants in the Intervention group when compared to participants in the Active Control group. According to a recent review of the literature, yoga appears to be an effective strategy for weight management and obesity prevention (Rioux & Ritenbaugh, 2013). Of the 23 studies included in the review, 22 studies (96%) established a quantitative reduction in weight, BMI, or body fat percentage. However, researchers noted that the studies varied in methodological rigor, sample sizes were small, and the content of yoga interventions varied widely, making comparisons difficult (Rioux & Ritenbaugh, 2013). The most

effective type of yoga and the specific dose of the intervention needed to maintain or lose weight remains unknown, especially among overweight and obese individuals.

There is a misconception that yoga is a type of low-intensity physical activity. While some yoga practices, such as breathing (*pranayama*) and mediation (*dhyana*), require little energy expenditure, other yoga practices, such as physical postures (*asana*), require a greater amount of energy expenditure (Ainsworth et al., 2000; Hagins, Moore, & Rundle, 200; Ray, Pathak, & Tomer, 2011). For example, a "sun salutation" in yoga, or a series of active postures linked together in a flowing sequence, has a metabolic equivalent (MET) between three and four, making it a moderate-intensity type of activity (Clay, Lloyd, Walker, Sharp, & Pankey, 2005). The Yoga for HEART Intervention sessions incorporated a range of standing, seated, supine, and prone postures linked together in a flowing sequence. Sun salutations were included to increase the energy expenditure of participants and achieve a moderate level of intensity. Participants in the Yoga for HEART Intervention group were also encouraged to engage in physical activity and health behavior outside of class, through walking and other types of activity. Several participants described efforts to become more active and consume a healthier diet. This comprehensive lifestyle approach to health behavior change may have contributed to significant differences in BMI between Intervention and Control groups.

Body composition. While no significant change was detected in waist-hip ratio (WHR) within or between groups, waist circumference decreased among participants in both Intervention and Active Control groups. In a recent systematic review and meta-analysis on the effect of yoga on weight-related outcomes, Lauche and colleagues (2016) found that yoga had a significant effect on WHR in healthy adults, but not overweight or

obese individuals, who were more likely to realize changes in BMI. Several of the participants in the Yoga for HEART Intervention study reduced their waist and hip circumference from baseline to 12 weeks, suggesting that the intervention was effective in improving body composition. Some participants lost more inches around their hips as compared to around their waist, causing an increase in WHR, rather than a decrease as expected. These findings have important implications for research and practice, as abdominal obesity (defined as a waist circumference > 35 inches in women and > 40 inches in men) is associated with an increased risk of CVD and related health conditions, independent of BMI (Yusuf et al., 2004).

Functional fitness. Participants in both Intervention and Active Control groups realized significant improvement in several functional fitness outcomes, including upper body strength, lower body strength, lower body flexibility, and dynamic balance, as measured with the Senior Fitness Test (Rikli & Jones, 2017). These findings are consistent with two meta-analyses of yoga interventions in promoting functional fitness in older adults. Youkhana and colleagues (2016) found that yoga effectively improved balance and mobility in older adults, measured with the Berg Balance Scale and the Short Physical Performance Battery, which include balance, lower body strength, and gait speed tests. Patel and colleagues (2012) found that the benefits of yoga interventions may exceed those of conventional physical activity programs in terms of strength, aerobic endurance, and self-rated health status. Both meta-analyses noted that sample sizes were small, and that the methodological quality of studies was mixed. The optimal intervention dose to improve mobility and function remain unknown, and it has not been determined if improvements in balance, strength, and gait speed translate to a reduction

in fall risk. Future research should include well-designed trials with larger sample sizes to determine the interventions and settings in which yoga is most effective in promoting functional fitness and preventing falls among older adults.

Limitations

Limitations of this study included: (a) a small, homogenous sample of community-dwelling older adults, reducing the generalizability of findings to other populations and settings; (b) limited ability to evaluate long-term maintenance of behavioral change and health outcomes.

This was a pilot feasibility study with a small sample size and limited statistical power to detect significant intervention effects. The sample was homogenous in terms of gender, race, ethnicity, and education, limiting the generalizability of study findings to other populations. English literacy as an inclusion criterion for study participation may have resulted in limited reach to the Hispanic community. As the proportion of ethnic minorities is growing in the older adult population, intervention research including ethnic minorities is essential to promoting health behavior change in a larger segment of society. Older adults from ethnic minority groups face unique and complex barriers to engaging in physical activity, and they experience a higher burden of chronic health conditions, including CVD (Ward et al., 2016). Future yoga intervention research should include older adults from diverse backgrounds and use culturally relevant strategies in study recruitment, implementation, and retention. Additionally, a larger sample size will increase the statistical power to detect significant intervention effects.

The Yoga for HEART Intervention was designed to increase physical activity and improve cardiovascular health in community-dwelling older adults. The findings from

this study may not be generalizable to older adults who reside in institutional settings, such as assisted living homes or long-term care facilities. Older adults who live in these settings may have low levels of physical activity and an elevated risk of CVD due to a range of personal, social, and environmental factors. Additional research would be useful to determine if yoga is effective in promoting physical activity and improving health outcomes in this vulnerable population.

This intervention research was a feasibility study and did not include evaluation for sustainability of effects using longer term follow-up. Evaluation of sustainability is important to determine if the intervention leads to continued awareness and use of social contextual resources, behavioral change processes, and cardiovascular health outcomes over time. Future research should include a longitudinal study design to evaluate the sustainability of intervention effects.

Strengths

Strengths of this study included the use of: (a) a randomized controlled trial (RCT) research design with double blinding; (b) a theory-based approach to intervention; (c) community-based research principles; and (d) objective measurement of physical activity. Improvements in theoretical mechanisms and expected outcomes indicate that the Yoga for HEART Intervention may effectively increase motivation for health behavior change and promote cardiovascular health in community-dwelling older adults at risk for CVD. The use of randomization and control strengthened the internal validity of this study, enabling researchers to draw causal inferences and rule out alternative explanations of intervention effects. The study participants and data collector were

blinded to group assignment (i.e., Intervention vs. Active Control), reducing potential sources of research bias and further strengthening internal validity.

This intervention study is one of few in the field of yoga research that has been guided by a theoretical perspective (Barrows & Fleury, 2016). Theory provides an understanding of the problem, the nature of the intervention to address the problem, and the mechanisms underlying the expected improvement in outcomes (Fleury & Sidani, 2012). Understanding the relationships between expected outcomes and mechanisms of action (i.e., the processes by which an intervention affects behavior) helps inform the systematic development of interventions targeting health behavior change (Michie et al., 2016). For interventions to be effective, their active components should target relevant mechanisms of action. In order to test theories of health behavior change, researchers should carefully link theoretical concepts to intervention components and select valid instruments to measure outcome variables consistent with theoretical propositions (Chase, 2013).

The use of WMT to guide the Yoga for HEART Intervention study enabled clear and specific identification of the problem addressed by the intervention. Rather than addressing general problems commonly identified in this field (i.e., physical inactivity and/or chronic health conditions), the intervention specified and addressed the source of the problem (i.e., low motivation for physical activity due to limited social contextual resources and behavioral change processes). Addressing the problem of limited motivation guided the identification of relevant theoretical mechanisms, selection of outcome variables, and inclusion of critical inputs. The use of theory in the design,

implementation, and evaluation of this study will facilitate future intervention research, continued theory development, and translation to practice (French et al., 2012).

The relevance of WMT concepts among community-dwelling older adults is supported by literature reviews and a concept analysis of wellness in older adults (Chase, 2012; McMahon & Fleury, 2012; Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017). The relevance of the theory-based Yoga for HEART Intervention was established through relationships with the community, not just individual research participants. Building community relationships involves gaining an understanding of, and respect for, community contexts (Israel et al., 2013; Minkler & Wallerstein, 2008). Relationship development was guided by principles of community-based research, including shared decisions about study design and implementation in the community. The research team was respectful of community interests and maintained openness to the ideas of community members about how they might benefit from the research or use the findings. Stakeholders other than potential participants were identified, including organizational leaders and members of WISE & Healthy Aging of Santa Monica, the Malibu Senior Center, Jewish Family Service of Los Angeles, and various healthcare providers and services in the West Los Angeles area, including UCLA Health Malibu and the Veterans' Administration Oxnard Community-Based Outpatient Clinic. Information about the study was presented to community stakeholders during several meetings and scheduled events. Feedback regarding intervention research was integrated in the research protocol. Findings will be disseminated to study participants and community stakeholders after dissertation approval.

This intervention study was one of few in the field of yoga research to measure physical activity objectively using the ActiGraph accelerometer. The advent of wearable technology (e.g, accelerometers and other mobile devices) to monitor physical activity has created an unprecedented opportunity to observe and quantify physical activity in real-world settings. While these devices enable researchers to better understand the associations between physical activity and related health outcomes, a consensus on the proper use of these devices in older adults has not been reached. Much of the validation research on wearable devices has been conducted in healthy young adults, limiting the translation of these methods to older populations (Schrack et al., 2016). Future research is needed to further explore how mobile devices might work to enhance and monitor the specific types of physical activity that are preferred by older adults, including yoga.

Implications for Nursing Science and Theory

Findings from this study provide empirical support for the Yoga for HEART Intervention in promoting wellness among community-dwelling older adults at risk for CVD, as explained by WMT. This was the first study in the field of yoga intervention research that used a theory-based approach to enhance motivation for physical activity and improve cardiovascular health in older adults. Results emphasize the importance of behavioral change processes and social contextual resources in the initiation and maintenance of health behavior change. It is within patterns of wellness motivation that individuals address representational processes (i.e., possible selves), evaluative processes (i.e., self-efficacy), and behavioral action (i.e., self-regulation), thereby enhancing social contextual resources and transforming goals and plans into desired outcomes (Fleury, 1991, 1996; Fleury & Sedikides, 2007). The focus on growth-oriented behavior based on

dynamic personal values and goals within WMT implies that a simple prescription or recommendation may be insufficient to change patterns of health behavior. Understanding motivational processes provides a basis for developing and testing personalized and flexible approaches that meet individual needs, goals, and preferences.

This feasibility study supports the acceptability and effects of responding to a public health problem using a strengths-based approach guided by middle range nursing theory. Wellness Motivation Theory reframes efforts to reduce cardiovascular risk into efforts to enhance motivation for health behavior change with a focus on personal values and goals (Fleury, 1991, 1996). Empirical findings from this study support the theoretical perspective that fostering motivation through social contextual resources and behavioral change processes can increase physical activity and improve health in community-dwelling older adults at risk for CVD. Findings from this study support the need for further testing of the Yoga for HEART Intervention to improve health in older adults across a range of community-based research settings, including senior recreation centers, assisted living facilities, rehabilitation clinics, and retirement communities.

The strengths-based perspective of WMT builds upon traditional theories of health behavior change by incorporating unitary transformative worldviews and broader unitary process models such as the Human Becoming School of Thought (Parse, 1988) and the Science of Unitary Human Beings (Rogers, 1988), in contrast to mechanistic worldviews and linear models of change. Traditional theories of health behavior change emerged from cognitive schools of thought emphasizing the role of beliefs and expectations in shaping behavior. In traditional theories, health behavior change is viewed as a linear process responding to a perceived susceptibility, deficit, or threat (e.g.,

fear of disease). Wellness Motivation Theory conceptualizes health behavior change as a dynamic process of intention formation and goal-directed behavior leading to the development of new and positive health patterns, consistent with personal values and goals (e.g., a desire to be well). Congruent with a unitary transformative worldview, WMT does not describe a linear process of change in wellness motivation. Rather, the theory explicates a continuous patterning of evolutionary growth in mutual process with the environment (Fleury, 1991, 1996; Parse, 1988). The theory acknowledges that with age there is unlimited potential for growth and development; aging is a process of increasing diversity, creativity, and complexity (Parse, 1988). The theory also acknowledges that across the lifespan, there are opportunities and constraints that shape the selection and pursuit of goals (Cross & Markus, 1991; Saajanaho et al., 2016). Individuals freely choose the personal meaning they assign to goals, thereby authoring their unique experiences of developmental growth and change (McMahon, 2012; Parse, 1988).

Implications for Research and Practice

Future yoga intervention should consider research designs and methods that balance elements of internal and external validity to foster translation of knowledge into practice (Bowen et al., 2009; Glasgow & Emmons, 2007). Specific considerations for future research include: (a) strengthening community partnerships consistent with principles of community-based research; (b) expanding feasibility research to include older adults from diverse backgrounds and settings, including ethnic minorities and individuals who reside in institutional settings; (c) examining the role of accelerometers

in augmenting yoga interventions; and (d) evaluating the long-term sustainability of effects.

Wellness Motivation Theoretical concepts, combined with the critical content of the Yoga for HEART Intervention, support several research agendas recommended by health experts, including the use of social and environmental approaches to promote physical activity in older adults (Hughes et al., 2011). Additional recommendations include examining the dose-response of specific physical activities (e.g., yoga), and developing ways to measure broader level factors (e.g., community, organizational, and policy) that influence the maintenance of health behavior change. Evaluation of the intervention across different community settings, ethnic groups, and levels of socioeconomic status will address health disparities due to physical inactivity and provide a basis for translation of research to practice (Hughes et al., 2011).

Further investigation is necessary to explicate the role of accelerometry in augmenting yoga interventions designed to increase physical activity in older adults. Additional research is warranted to develop and test methods for estimating the energy expenditure of yoga and identifying patterns of physical activity in older adults that are meaningful to participants and researchers. The use of participant feedback in addition to physical activity monitoring could be more effective in changing behavior. The application of mobile technology to yoga interventions offers an innovative way to enhance motivation for health behavior change and capture patterns of physical activity in older adults.

Longitudinal studies will facilitate understanding of long-term behavioral maintenance and sustainability of intervention effects. Few yoga interventions designed

to improve health in older adults have included extended follow-up to evaluate sustainability (Barrows & Fleury, 2016). It remains unclear what is needed to optimize and maintain the effects of interventions over time. Longitudinal evaluation of the Yoga for HEART Intervention may begin to address these gaps in knowledge.

This research study was guided by several principles of community-based research that included: (a) recognizing the community as a unit of identity, (b) emphasizing the relevance of community-defined problems, and (c) building on community strengths and resources. Future research will place a greater emphasis on the participatory aspects of the community-based approach that include strengthening community partnerships, developing a collaborative project with co-defined goals, and balancing the benefits of research between science and the community (Israel et al., 2008; Minkler & Wallerstein, 2008). Further testing of Yoga for HEART could evaluate the relative contribution of community partnerships to the feasibility of the intervention.

Collaboration between scientists, theorists, and practitioners will create opportunities to develop interventions that address the public health problem of CVD in older adults. Findings from this study have important implications for research and practice, including the further development of a theory-based intervention to enhance wellness motivation among community-dwelling older adults at risk for CVD. The Yoga for HEART Intervention uses person-centered strategies that are manualized and accessible to nurses and other healthcare professionals. Critical content promoting motivational support guides interventionists in exploring the personal values, goals, and strengths of participants as they develop plans and strategies for physical activity and health behavior change. Intervention critical content also emphasizes social network

support and empowering education (e.g. identifying personal and community resources), enabling the potential to impact community and environmental level factors that promote healthy aging.

Summary

In summary, this study supports the feasibility and efficacy of the Yoga for HEART Intervention in community-dwelling older adults at risk for CVD. Intervention acceptability, demand, and implementation fidelity were evaluated as very good. The intervention effectively increased theoretical mechanisms of change, including behavioral change processes (i.e., self-knowledge, motivation appraisal, and self-regulation) and social contextual resources (i.e., social support and environmental resources). The intervention improved cardiovascular health and functional fitness outcomes, including BMI, body composition, strength, flexibility, and balance. Cardiovascular disease is the leading cause of mortality among older adults. As the population ages, the incidence and prevalence of CVD is predicted to rise. The development, testing, and translation of theory-based yoga interventions to enhance motivation for physical activity and promote cardiovascular health in older adults can contribute meaningfully to reducing the personal and socioeconomic burden of CVD in this vulnerable and underserved population.

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APPENDIX A

CONSENT FORM

CONSENT FORM TO PARTICIPATE IN A RESEARCH PROJECT TO ENHANCE MOTIVATION FOR PHYSICAL ACTIVITY AND PROMOTE CARDIOVASCULAR HEALTH

INTRODUCTION

The purposes of this form are to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research and to record the consent of those who agree to be involved in the study.

RESEARCHERS

Julie Fleury, PhD, RN, Arizona State University, College of Nursing and Health Innovation and Jennifer Barrows, BSN, Doctoral Student, Arizona State University, College of Nursing and Health Innovation have invited your participation in a research study.

STUDY PURPOSE

The purpose of this study is to evaluate the benefits of a yoga-based intervention designed to enhance motivation for physical activity and promote cardiovascular health. If you say YES, your participation will last for 12 weeks at a local yoga studio.

DESCRIPTION OF THE RESEARCH STUDY

If you decide to participate in this study, you will be interviewed over the telephone to ensure that you are eligible to participate in the study by asking you questions about:

- Your current level of physical activity and mental status
- Your health history with information about current medications
- Your readiness for physical activity using a brief questionnaire

If the telephone screening indicates that you may be at risk for injury, we will refer you to your primary care physician for clearance to participate in physical activity.

If you qualify for the study and are interested in participating, you can choose to sign this informed consent form after all of your questions have been answered. After the informed consent form is signed, data will be collected at two different time points. The first data collection time point will be immediately after you sign the consent form. The second data collection time point will be after 12 weeks. Each data collection time point will take approximately an hour to complete. During the first data collection time point we will ask you questions about:

- Your contact information (i.e., address, phone number)
- Your marital status, employment, and educational level

During each of the two 60-minute data collection time points we will also ask you about:

- Your feelings about being physically active
- Your level of support from family and friends
- Your assessment of community resources for physical activity

During each of the two 60-minute data collection time points we will also:

- Assess your blood pressure and body composition using noninvasive measures
- Measure your endurance, strength, balance, and flexibility by watching you sit, stand, and walk
- Ask you to wear a lightweight motion sensor during waking hours for 7 days to measure your activity patterns

Each individual data collection time will be arranged at your convenience. You will receive instructions on how to wear the motion sensor and receive a postage-paid envelope to return the device after wearing it for a period of one week. The motion sensor is designed to measure the amount of time you spend in physical activity; it will not track your location, provide details about the types of activities you do throughout the day, or collect other types of information.

After the first data collection interview and session is complete, the 12-week study will begin. Yoga study participants will meet at a local yoga studio once per week for a total of 12 weeks. The instructor will guide you through a beginner yoga practice designed and tested by an expert in yoga-based physical activity to promote healthy aging. The intensity of the yoga program will be adjusted to meet your personal goals, needs, and preferences. Over the course of 12 weeks, new activities will be introduced gradually to allow you time to learn them and build your strength and abilities. Yoga will be practiced for a few minutes during the first group session. Over time, the amount of time spent practicing yoga will slowly increase to last approximately 45 minutes. A variety of props will be used for support, including chairs and the wall.

RISKS

We do not anticipate any serious risks associated with your participation in this study. There is a potential for minimal psychological or social discomfort when completing surveys or attending group sessions. You may experience minor physical discomfort or soreness when you start the physical activity program. This is expected and typically improves with continued activity. There is a slight

risk that you might injure a muscle while doing some of the activities. If you are injured, you or your insurer will be responsible for the costs of treating the injury. As is true with any research, there is also some possibility that you may be subject to risks that have not yet been identified. Dr. Julie Fleury and Ms. Jennifer Barrows will be available for consultation, should the need arise, at (602) 496-0773, jfleury@asu.edu and jlbarrow@asu.edu.

BENEFITS

The possible benefits of your participation in the study may include improvement of your knowledge and skills related to health, wellness, and physical activity in older adults.

CONFIDENTIALITY

All information obtained in this study is strictly confidential unless disclosure is required by law. The results of this research study may be used in reports, presentations, and publications, but

Some groups will also engage in group discussions to identify personal, social, and community resources for physical activity and healthy behavior. Group sessions will be audiotaped and randomly audited to verify that the content delivery is consistent with the study protocol the researchers will not identify you. In order to maintain confidentiality of your records, a number will be assigned to your name and any personal information will be stored in locked files.

COSTS AND PAYMENTS

The researchers want your decision about participation in the study to be absolutely voluntary, yet they recognize that participation may pose some inconvenience to you. In order to express appreciation for the time and effort you provide to be in the study, we will provide a $20 gift card for each data collection session. There are two data collection time points in the study. You will receive up to $40 in gift cards for being in the study.

VOLUNTARY CONSENT

If you agree to participate in the study, then your consent does not waive any of your legal rights. If you have any questions concerning the research study or your participation in the study, before or after your consent, please contact Ms. Jennifer Barrows at jlbarrow@asu.edu or (310) 993-4355 or Dr. Julie Fleury at jfleury@asu.edu or (602) 496-0773. For information on the legal rights of research participants, please contact the Institutional Review Board at Arizona State University at (480) 965-6788. This form explains the nature, demands, benefits, and any risks of the project. By signing

this form, you agree knowingly to assume any risks involved. Remember, your participation is voluntary. You may choose not to participate or to withdraw your consent and discontinue participation at any time without penalty or loss of benefit. In signing this consent form, you are not waiving any legal claims, rights, or remedies. A copy of this consent form will be provided to you.

Your signature below indicates that you consent to participate in the above study.

_____ _____ _____

Participant's Signature Printed Name Date

INVESTIGATOR'S STATEMENT

I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature. I have provided the participant with a copy of this signed consent document.

_____ _____ _____

Investigator's Signature Printed Name Date

APPENDIX B

DATA COLLECTION PACKET

Participant ID# _____ Date: _____

Demographic Questionnaire

The first set of questions is about you, your age, etc. These are similar to questions the census bureau asks you. In this project, we will not attach your name or any form or personal identification, other than your study number, to the information you provide. We keep all information you provide safeguarded and do not share your individual information with anyone. I will read the question and you provide the answer.

1. Date of birth (mm/dd/yr): ____/____/____

(DOB)

2. What is your gender? ____ Female ____ Male

(SEX)

3. What is your ethnicity?

(ETHNICITY)

a. Hispanic or Latino
b. Non-Hispanic or Latino

4. What is your race (circle all that apply)?

(RACE)

a. White
b. Black or African American
c. Asian (please specify, for example, Korean, Japanese, Chinese) _____

(OTHERA)

d. American Indian or Alaskan Native (please specify tribe) _____

(TRIBE)

e. Native Hawaiian or Pacific Islander (please specify) _____

(OTHERPI)

f. Other (please specify) _____

(OTHERR)

5. What is your marital status?

(MARITAL)

a. Married
b. Separated
c. Divorced
d. Widowed
e. Never married

6. How many years of school have you completed? _____

(EDUCATION)

7. Tell me about your employment. Are you:

(EMPLOY)

a. Retired
b. Employed part time

c. Employed full time
d. Unemployed
e. Not employed
f. A volunteer

8. Do you find it easy to pay your monthly living expenses?

(INCOME)

a. Yes
b. No

Yoga for HEART

DATA COLLECTION PACKET

Participant ID _____

Date _____

Data Collector _____

Thank you again for participating in the Yoga for HEART research study! As you remember, the purpose of this program is to promote wellness. As a part of the study, we will be asking questions about you and your health. Your responses to questions are not graded; there is no right or wrong answer. We value your thoughts and experiences, as they will help us learn about promoting wellness in the future.

- First, we will begin with a set of questions about you, your health goals, your level of social support, and your community resources for being active.
- Next, we will measure your blood pressure, body composition, and observe your physical movements (for example, sitting, walking, and standing).
- Finally, we will give you a physical activity monitor with instructions to wear for the next week.

We are very flexible, so if at any time you want to take a break or have questions, please let us know! *Let's get started.*

Self-Knowledge Inventory

This set of questions is about your thoughts related to yourself and your health. Most people think about their health to some extent. When doing so, we usually think about the kinds of experiences that are possible for us and what our health might be like. Please take a few moments to think about yourself and your health.

1. Please list one health issue that concerns you most, or that you think needs improving:

_____

2. What goals have you set to improve your health related to this issue?

_____

_____

3. What activities are you currently doing or thinking about doing to improve your health related to this issue?

_____

_____

_____

		I'm sure I can	Maybe I can	I'm sure I cannot
4.	How able do you feel that you can perform your activities listed, on a regular basis? (Please circle one number).	1	2	3
5.	How likely do you think it is that you will achieve your goals? (Please circle one number).	1	2	3

Index of Readiness

This set of questions reflects how people feel about the ways they try to stay active. Please answer each statement by first thinking about the statement, and then circle the response that best describes the extent to which you agree or disagree with the statement.

		Strongly Disagree	Disagree	Somewhat Agree	Agree	Strongly Agree
1.	I think about what might happen if I don't begin a program of physical activity.	1	2	3	4	5
2.	I don't participate in physical activity as often as I feel that I could.	1	2	3	4	5
3.	I think that I need to change some of the things that keep me from being physically active.	1	2	3	4	5
4.	I have planned new ways to stay physically active.	1	2	3	4	5
5.	I have thought about new ways I can make physical activity fit into my life.	1	2	3	4	5
6.	I have a plan for how to overcome barriers to regular physical activity.	1	2	3	4	5
7.	I am willing to make sacrifices in order to participate in physical activity on a daily basis.	1	2	3	4	5
8.	I am determined to succeed in making physical activity a part of my life.	1	2	3	4	5
9.	I am committed to making lasting changes in the ways that I stay physically active.	1	2	3	4	5

Index of Self-Regulation

The next group of questions contains statements that describe how people feel about how they stay active. Please answer each statement by first thinking about the statement, and then circle the response that best describes the extent to which you agree or disagree with the statement.

		Strongly Disagree	Disagree	Somewhat Agree	Agree	Strongly Agree
1.	I think of the benefits of regular physical activity.	1	2	3	4	5
2.	I remind myself of the good I am doing by participating in physical activity.	1	2	3	4	5
3.	I remind myself of the importance of physical activity.	1	2	3	4	5
4.	I keep track of the ways that I stay physically active.	1	2	3	4	5
5.	I watch for signs of progress as I stay physically active.	1	2	3	4	5
6.	I monitor myself to see if I am meeting my goals for physical activity.	1	2	3	4	5
7.	I have learned new habits that help me to participate in physical activity.	1	2	3	4	5
8.	I have learned new ways to keep physically active.	1	2	3	4	5
9.	I have learned to make changes in my physical activity that I can live with.	1	2	3	4	5

Social Support and Exercise Survey

Below is a list of things that family or friends might do or say to help someone become or stay active. Please rate how often a family member, friend, or anyone living in your household has done or said the following items during the past three months. Please read and answer every question.

During the **past three months**, my family, friends, or household members (please circle one for each question):

	Never	Rarely	A Few Times	Often	Very Often
1. Participated in physical activity with me.	1	2	3	4	5
2. Offered to participate in physical activity with me.	1	2	3	4	5
3. Gave me helpful reminders to be physically active.	1	2	3	4	5
4. Gave me encouragement to be physically active.	1	2	3	4	5
5. Changed their schedule so we could be physically active together.	1	2	3	4	5
6. Discussed physical activity with me.	1	2	3	4	5
7. Helped by scheduling other commitments around my activity.	1	2	3	4	5
8. Asked me for ideas on how they might be more physically active.	1	2	3	4	5
9. Talked about how much they like to stay physically active.	1	2	3	4	5

Community Resources

The next 3 pages will ask you questions about your neighborhood and community.

Referring to the following scale: please **circle a number (1 – 5)** in the response section that corresponds to the frequency with which you have participated in these activities.

	Not At All	Rarely	A Few Times	Often	Very Often
1. During the past 3 months how often have you walked or strolled in your neighborhood?	1	2	3	4	5
2. During the past 3 months how often have you walked or done any other physical activity with your neighbors?	1	2	3	4	5
3. During the past 3 months how often have you gone to a neighborhood park for walks or other physical activities?	1	2	3	4	5

Let's talk about the places where you are active and the resources available for being active. Referring to the following scale, please **circle the number (1 – 5)** in the response section that corresponds to the extent to which you agree or disagree with each statement.

	Strongly Disagree	Disagree	Somewhat Agree	Agree	Strongly Agree
4. There are no hills in my neighborhood.	1	2	3	4	5
5. My neighborhood streets are well lit at night.	1	2	3	4	5
6. There are safe places to walk in my neighborhood.	1	2	3	4	5
7. There are many attractive natural sights in my neighborhood.	1	2	3	4	5

8. Many people walk and participate in physical activities frequently (3 – 5 times per week) in my neighborhood.	1	2	3	4	5
9. My community gets its fair share of public money to spend on recreation areas and facilities.	1	2	3	4	5

10. How would you describe your neighborhood? (Circle your answer).
    a. rural country
    b. residential
    c. mixed residential/commercial
    d. mainly commercial

11. If you are active outside of your home or neighborhood, what is the distance in miles to the place where you perform most of your activity (for example, walking, strength, or balance activities)? _____ miles. (If you do physical activity inside your home or in your neighborhood, write "0" in the blank).

12. Please list community organizational resources available to help you stay physically active through walking, strengthening, flexibility, or balance activities:

Resource(s)	Times used per **month**
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____

Participant ID# _____ Date: _____

Data Collection Worksheet

Check one:

☐ Baseline (T1)

☐ 12 Weeks (T2)

Item	Trial 1	Trial 2	Comments
1. Blood Pressure: (mmHg) (BP)			
a. Right arm:	_____	_____	_____
b. Left arm:	_____	_____	_____
2. Height: (HT) (nearest ½ cm)	_____	___N/A____	_____
3. Weight: (WT) (nearest ½ kg)	_____	___N/A____	_____
4. Waist circumference: (WC) (nearest ½ cm)	_____	___N/A____	_____
5. Hip circumference: (HC) (nearest ½ in)	_____	___N/A____	_____
6. Chair stand: (CS) (# in 30 sec)	_____	___N/A____	_____
7. Arm curl: (AC) (# in 30 sec)	_____	___N/A____	_____
8. 2-minute step: (2MS) (# of steps)	_____	___N/A____	_____

9. Sit-and-reach: _____ _____ _Right or Left (extended leg)__
(SR)
(nearest ½ in: +/-)

10. Back scratch: _____ _____ _Right or Left (over shoulder)_
(BS)
(nearest ½ in: +/-)

11. 8-ft up-and-go: _____ _____ _____
(UG)
(nearest 1/10 sec)

APPENDIX C

SCREENING TOOLS

PAR-Q+

Physical Activity Readiness Questionnaire for Everyone

Regular physical activity is fun and healthy, and more people should become more physically active every day of the week. Being more physically active is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor before becoming more physically active.

SECTION 1 – GENERAL HEALTH

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.			
		YES	NO
1.	Has your doctor ever said that you have a heart condition OR high blood pressure?	☐	☐
2.	Do you feel pain in your chest at rest, during your activities of living, OR when you do physical activity?	☐	☐
3.	Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4.	Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?	☐	☐
5.	Are you currently taking prescribed medications for a chronic medical condition?	☐	☐
6.	Do you have a bone or joint problem that could be made worse by becoming more physically active? Please answer NO if you had a joint problem in the past, but it does not limit your current ability to be physically active. For example, knee, ankle, shoulder or other.	☐	☐
7.	Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.

☑ Go to Section 3 to sign the form. You do not need to complete Section 2.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow the physical activity guidelines for your age.
- You may take part in a health and fitness appraisal.
- If you have further questions, consult a qualified health care professional.
- If you are NOT accustomed to regular vigorous physical activity, please consult

a qualified health care professional before engaging in maximal effort exercise.

If you answered YES to one or more of the questions above, please GO TO SECTION 2.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as a cold or fever – wait until you feel better.
- Your health changes – please answer the questions on Section 2 of this document and/or talk to your doctor before continuing with any physical activity program.

SECTION 2 – CHRONIC MEDICAL CONDITIONS

Please read the questions below carefully and answer each one honestly: check YES or NO.				
			YES	NO
1.	Do you have Arthritis, Osteoporosis, or Back Problems?		☐ If yes, answer questions 1a-1c	☐ If no, go to question 2
	1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondlyolisthesis) and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	☐	☐
	1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	☐	☐
2.	Do you have Cancer of any kind?		☐ If yes, answer questions 2a-2b	☐ If no, go to question 3
	2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and neck?	☐	☐

	2b.	Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)?	☐	☐
3.	Do you have Heart Disease or Cardiovascular Disease? This includes Coronary Artery Disease, High Blood Pressure, Heart Failure, Diagnosed Abnormality of Heart Rhythm		☐ If yes, answer questions 3a-3e	☐ If no, go to question 4
	3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	3b.	Do you have an irregular heart beat that requires medical management? (e.g. atrial fibrillation, premature ventricular contraction)	☐	☐
	3c.	Do you have chronic heart failure?	☐	☐
	3d.	Do you have a resting blood pressure equal to or greater than 160/90 with or without medication? (Answer YES if you do not know your resting blood pressure)	☐	☐
	3e.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	☐	☐
4.	Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes		☐ If yes, answer questions 4a-4c	☐ If no, go to question 5
	4a.	Is your blood sugar often above 13.0mmol/L? (Answer YES if you are not sure)	☐	☐
	4b.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, and the sensation in your toes and feet?	☐	☐
	4c.	Do you have other metabolic conditions (such as thyroid disorders, pregnancy-related diabetes, chronic kidney disease, liver problems)?	☐	☐
5.	Do you have any Mental Health Problems or Learning Difficulties? This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome)		☐ If yes, answer	☐ If no,

			questions 5a-5b	go to question 6
	5a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	5b.	Do you also have back problems affecting nerves or muscles?	☐	☐
6.	Do you have a Respiratory Disease? This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure		☐ If yes, answer questions 6a-6d	☐ If no, go to question 7
	6a.	Do you have difficultly controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	6b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	☐	☐
	6c.	Has your doctor ever said that you have high blood pressure in the blood vessels of your lungs?	☐	☐
7.	Do you have a Spinal Cord Injury? This includes Tetraplegia and Paraplegia		☐ If yes, answer questions 7a-7c	☐ If no, go to question 8
	7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	7b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	☐	☐
	7c.	Has your physician indicated that you have sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	☐	☐
8.	Have you had a Stroke? This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event		☐ If yes, answer	☐ If no,

			questions 8a-c	go to question 9
	8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	8b.	Do you have any impairment in walking or mobility?	☐	☐
	8c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	☐	☐
9.	Do you have any other medical condition not listed above or do you live with two chronic conditions?		☐ If yes, go to questions 9a-9c	☐ If no, read the advice on page 4
	9a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed concussion within the last 12 months?	☐	☐
	9b.	Do you have a condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	☐	☐
	9c.	Do you currently live with two chronic conditions?	☐	☐

Please proceed to Page 6 for recommendations for your current medical condition and sign this document.

☑ If you answered NO to all of the follow-up questions about your medical condition, you are ready to be more physically active:

- It is advised that you consult a qualified health care professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually – 20 to 60 minutes of low- to moderate-intensity exercise, 3 to 5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate- intensity physical activity per week.
- If you are NOT accustomed to regular vigorous physical activity, please consult a qualified health care professional before engaging in maximal effort exercise.

If you answered YES to one or more of the follow-up questions about your medical condition:

- You should seek further information from a licensed health care professional before becoming more physically active or engaging in a fitness appraisal.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as cold or fever – wait until you feel better
- Your health changes – please talk to a doctor before continuing with any physical activity program.

Stages of Change Questionnaire

For each of the following questions, please circle yes or no. Please be sure to read the question carefully.

Physical activity or exercise includes activities such as walking briskly, jogging, bicycling, swimming, or any other activity in which the exertion is at least as intense as these activities.

	No	Yes
1. I am currently physically active.	0	1
2. I intend to become more physically active in the next 6 months.	0	1
For activity to be *regular*, it must add up to a *total* of 30 minutes or more per day and be done at least 5 days per week. For example, you could take a 30-minute walk or take three 10-minute walks for a daily total of 30 minutes.		
	No	**Yes**
3. I currently engage in *regular* physical activity.	0	1
4. I have been *regularly* physically active for the past 6 months.	0	1

Scoring Algorithm

If question 1 = 0 and question 2 = 0, then you are at stage 1 (not thinking about change).
If question 1 = 0 and question 2 = 1, then you are at stage 2 (thinking about change).
If question 1 = 1 and question 3 = 0, then you are at stage 3 (doing some physical activity).
If question 1 = 1, question 3 = 1, and question 4 = 0, then you are at stage 4 (doing enough physical activity).
If question 1 = 1, question 3 = 1, and question 4 = 1, then you are at stage 5 (making physical activity a habit).

Mini Mental State Exam
Telephone Version

Maximum	Score	
		Orientation
1	_____	Please provide a phone number where you can be reached.
5	_____	What is the (year) (season) (date) (day) (month)?
4	_____	Where are we (state) (country) (town) (building)?
		Registration
3	_____	Name all 3 objects: 1 second to say each. Then ask the person all 3 after you have said them. Give 1 point for each correct answer. Then repeat until he/she learns all 3. Count trials and record. Trials _____
		Attention and Calculation
5	_____	Spell the word "world" backwards.
		Recall
3	_____	Ask for the 3 objects repeated above. Give 1 point for each correct answer.
		Language
1	_____	Name the object you are speaking into.
1	_____	Repeat the following: "No ifs, ands or buts."
3	_____	Follow a 3-stage command: "Say hello, tap the mouthpiece three times, then say 'I'm back.'"

_____/26 **Total Score**