Enhancing Motivation for Physical Activity to Reduce Fall Risk Among Community Dwelling Older Adults

by

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ABSTRACT

Unintentional falls among community dwelling older adults are a common, serious and potentially preventable public health problem. In the United States, the annual incidence of fall related injuries per 100,000 persons was 4,616 in 2001, rising to 5,252 in 2008. The annual incidence of fall related deaths per 100,000 persons was 29.3 in 2000, rising to 41.86 in 2006. Older adults are particularly vulnerable to falls as they age. Potential consequences include fractures, emergency room, hospital and nursing home admissions, dependence, confusion, immobilization, depression, and death. Significant modifiable fall risk factors include muscle weakness, gait problems, and balance problems. While researchers have demonstrated the positive effects of balance and leg-strengthening physical activities, the majority of older adults do not engage in them, and the rate of falls continues to increase. Older adults participate in regular physical activity and fitness activities less often than younger populations; disparities are greater among those who are poor and living in rural communities. While knowledge about causes, risk factors, and efficacious physical activity to prevent falls has grown exponentially in the last several decades, bridging the gap between research and practice continues to be a challenge. As a strategy to address the gap between research and practice, this feasibility study utilized a tested theory, the wellness motivation theory, to address motivation for behavioral change in combination with instruction for physical activities proven to reduce fall risk. The study sample included rural, community dwelling older adults at risk of falls. The study included an innovative mobile computer to measure

physical activity behavior and to augment motivational content of the intervention. Specific aims of this feasibility study were to: (a) examine the acceptability, demand, and implementation of the wellness motivation intervention (WMI) and the technology augmenting the intervention; and (b) evaluate the efficacy of the WMI to increase awareness of social contextual resources, behavioral change processes, physical activity, and to decrease fall risk. In this study the WMI delivered in combination with proven multicomponent balance and strength activities was feasible and effectively increased motivation for behavioral change (social support from friends, awareness of social contextual resources, behavioral change processes) and physical activity behavior, and decreased fall risk among rural, community-dwelling older adults at risk of falls. This study is the first step in a program of research focusing on enhancing motivation for physical activity that reduces falls and frailty among older adults.

DEDICATION

This dissertation is dedicated to my parents, Mary Margaret and Jack McMahon, who teach their children well by being open, curious, and ever learning. I appreciate how their enthusiastic support has been instrumental in my own pursuit of new knowledge.

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TABLE OF CONTENTS

Page

CHAPTER Page

LIST OF TABLES

LIST OF FIGURES

OPERATIONAL DEFINITIONS

Exercise	A subset of physical activities planned, structured, repetitive, and purposive (Spirduso, Francis, & McRae, 2005).
Physical Activity	Any bodily movement produced by skeletal muscles that results in energy expenditure including exercise, sports, and physical activities that are part of everyday living (Spirduso et al., 2005).
Inactivity	Less than 10 minutes per week of moderate or vigorous intensity lifestyle activities (e.g., household work) or leisure time activities (e.g., running, golf, walking) (Centers for Disease Control and Prevention [CDC], 2010).
High-Light Intensity Physical Activity	A subset of light intensity activities perceived as fairly light to moderate (e.g., walking briskly, balance exercises) and with absolute energy expenditure estimations of 2.0 - 3.0 metabolic equivalents (Buman et al., 2010; Copeland & Esliger, 2009; Hekler et al., 2012a).
Leisure-Time Inactivity	No reported leisure-time physical activities (e.g., walking, calisthenics, gardening) (CDC, 2010).
Light Intensity Physical Activity	Light activities perceived as very light to fairly light physical exertion (Garber et al., 2011) with absolute energy expenditure estimates of 1.0-3.0 metabolic equivalents

	(Buman et al.,2010; Copeland & Esliger, 2009; Hekler et al., 2012a).
Low-Light Intensity Physical Activity	A subset of light intensity activities perceived as very light (Garber et al., 2011) (e.g., standing or playing cards) with absolute energy expenditure estimations of > 1 and $\leq$ 2 metabolic equivalents (Buman et al., 2010; Hekler et al., 2012a).
Moderate/ Vigorous Physical Activity	Activities perceived as fairly light to very hard (e.g., walking briskly, swimming) and with estimates of absolute energy expenditure estimations of > 3 metabolic equivalents (Stewart et al., 2000).
Sedentary Behavior	A distinct class of behaviors that involve quietly sitting and low levels of energy expenditure, typically 1.0 metabolic equivalents (Garber et al., 2011).

Chapter 1

INTRODUCTION

Approximately 28-35% of people 65 years old and older fall each year (World Health Organization [WHO], 2007). Despite findings describing the causes and correlations of fall occurrence and the efficacy of preventive interventions, falls continue to be the leading cause of injurious deaths among older adults, and their incidence is increasing (Centers for Disease Control and Prevention [CDC], 2011). Healthy People objectives (U.S. Department of Health and Human Services [DHHS], 2011a) and the falls prevention for active aging model published by the WHO (2007) both address the importance of regular physical activity across older adult populations. Among the major modifiable risk factors for falls in older adults, leg weakness, gait changes, and imbalance have been identified as the most significant (American Geriatrics Society [AGS], British Geriatrics Society, American Academy of Orthopedic Surgeons, & Panel of Falls Prevention, 2001). This chapter provides an overview of the social and economic burden of falls in the United States, the impact of falls on older adults, the role of physical activity in reducing leg weakness, imbalance, and preventing falls, physical activity interventions targeting fall prevention in older adults, and the strengths and limits of research in this field. The chapter will conclude with specific aims that include testing a theory-based intervention to promote motivation for physical activity and falls prevention in community dwelling older adults.

The Social and Economic Burden of Falls in Older Adults

In 2009, the rate of falls among women and men over the age of 64 was 41.7 and 48.8 per 100,000 persons respectively (CDC, 2011a). In 2007, the rate of nonfatal injurious falls among women and men over the age of 64 was 6,070 and 3,738 per 100,000 persons respectively (CDC, 2011a). Women tend to fall more often and sustain more hip injuries than men, while men tend to die from falls more often than women. National data do not describe nonfatal injurious rates by race, but mortality data reveal that Whites die from falls (44.46 per 100,000) more often than Blacks (19.92 per 100,000), Asians (30 per 100,000), Hispanics (26.84 per 100,000), or American Indians (28 per 100,000) (CDC, 2011a; Yoshida, 2007). Those who are 85 years old and older experience more fatal and nonfatal injurious falls (151.93 and 11,079 per 100,000 respectively) compared with those between 75 and 84 years old (47.69 and 5,761 per 100,000 respectively) and those between 65 and 74 years old (12.65 and 2,929 per 100,000 respectively) (CDC, 2011a; Yoshida, 2007). Direct medical costs of falls in the United States for persons aged 65 and older in 2005 totaled $19.4 billion; predictions for 2020 are $43.8 billion (CDC, 2011a; Stevens, Corso, Finkelstein, & Miller, 2006).

Risk factors for falls. In addition to age, physical, behavioral, and environmental risk factors have been identified. Among risk factors identified as having the highest mean relative risk are lower extremity weakness (4.4), history of falls (3.0), gait and balance deficits (2.9), use of assistive devices (2.6), visual deficits (2.5), arthritis (2.4), impaired ability to do activities of daily living (2.3),

depression (2.2), and cognitive impairment (1.8.) (AGS et al., 2001). Additional conditions such as cerebrovascular disease (Nevitt, Cummings, Kidd, & Black, 1989), diabetes (Hanlon, Landerman, Fillenbaum, & Studenksi, 2002), Parkinson's disease (Balash et al., 2005), urinary incontinence (Brown et al., 2000), and orthostatic hypotension (Heitterachi, Lord, Meyerkort, McCloskey, & Fitzpatrick, 2002) have also been associated with falls. Medication issues including taking four or more medications, taking medications affecting the central nervous system, or taking certain cardiovascular medications have been associated with a higher risk of falling (Hanlon et al., 2002; Leipzig, Cumming, & Tinetti, 1999a, 1999b; Nevitt et al., 1989). Potentially hazardous situations within home and outdoor environments also create risks for falls, but their causal mechanisms remain unclear (Lord, Sherrington, Menz, & Close, 2007).

Consequences of falls. The negative impact that falls and related injuries have on quality of life is significant. Twenty to thirty percent of older adults who fall suffer moderate to severe injury, such as traumatic brain injury and fractures (Sleet, Moffett, & Stevens, 2008). In 2005, 15,000 older adults in the United States died after falling, and 1.8 million were admitted to hospitals for treatment of fall-related injuries (Sleet et al., 2008). As many as 32% of older adults require assistance with activities of daily living for up to six months after experiencing an injurious fall (Schiller, Kramarow, & Dey, 2007). In their prospective study of community dwelling older adults, Tinetti and Williams (1997) reported that participants who experienced one fall had a relative risk of 3.3 for nursing home admission. The relative risk among older adult participants experiencing two or

more non-injurious or seriously injurious falls increased to 5.5 and 10.2 respectively (Tinetti & Williams, 1997). A history of two or more falls is an independent risk factor for fear of falling (Lach, 2005). Between 23% and 43% of older adults experience fear of falling, which has been associated with restricted activity, fear of embarrassment, and fear of losing independence (Lach, 2005; Yardley & Smith, 2002).

Physical Activity in Older Adults

Healthy People objectives (DHHS, 2011a) and the falls prevention for active aging model published by the WHO (2007) both address the importance regular physical activity across older adult populations. The age-related musculoskeletal changes that predispose older adults to leg weakness, imbalance, and falls can be attenuated with the adoption and maintenance of multi-dimensional physical activities including those that promote leg strength and balance (Gillespie et al., 2009; Singh, 2002). Sedentary behavior is significant across the life-span, but is more frequent among those over 60 years old (Matthews et al., 2008). Survey reports estimate that approximately 70% of persons over the age of 74 do not engage in physical activities on a regular basis; only 12% engage in muscle-strengthening activities (National Center for Health Statistics [NCHS], 2012). Leisure time inactivity is highest among Hispanics and lowest among Whites (NHCS, 2012). Other factors, such as residing outside metro areas, high school or lower level of education, and incomes below poverty rates are associated with leisure time inactivity (NHCS, 2012). The leisure time inactivity rate among persons living in metropolitan areas is 47.8%, compared to

56.9% among persons outside metropolitan areas (NHCS, 2012). Despite our knowledge about sedentary lifestyle trends among older adults, little is known about the influence that socioeconomic status and geographic location have on these trends (Todd, Ballinger, & Whitehead, 2008). Additionally, little is known about the feasibility of fall prevention interventions among older adults who are rural dwelling and of lower socioeconomic status (Rose, 2009).

Motivation for Physical Activity in Older Adults

An in-depth understanding of the determinants of older adult physical activity initiation and maintenance requires a focus on motivation for physical activity. According to existing research, many older adults are strongly driven by health preventive goals aimed at maintaining health and decreasing health risk (Kolt, Driver, & Giles, 2004; Renner, Spivak, Kwon, & Schwarzer, 2007; Wilcox, Tudor-Locke, & Ainsworth, 2002). However, promoting physical activity in older adults may be difficult because of a wide range of actual and perceived barriers that reduce motivation for activity. For example, limited awareness about the benefits of physical activity, perceptions of poor health, and beliefs that physical activities cause injury or are too strenuous have all been identified as barriers to motivation for physical activity among older adults (Brawley, Rejeski, & King, 2003; Dye & Wilcox, 2006; Schutzer & Graves, 2004). Motivation is also diminished by messages that directly or indirectly treat older people as if they are frail, which reinforces community and individual beliefs that inactivity is to be expected with age and chronic illness (Brawley et al., 2003). Motivation for physical activity is correlated with (a) social support from family, friends,

program staff, peers, and health care providers; and (b) programs that are reasonably priced, simple, and convenient (Brawley et al., 2003; Dye & Wilcox, 2006).

Physical Activity Interventions to Reduce Falls

In a recent meta-analysis of fall prevention interventions, Gillespie and colleagues (2009) concluded that multiple component exercises and Tai Chi in group settings or as individualized prescriptions were effective in reducing fall occurrence and risk, and reported risk ratios with 95% confidence intervals as 0.78 [.71-.86] and .83 [.72-.97] respectively. Additional articles have provided integrative reviews of physical activity intervention characteristics and efficacy (Conn, Minor, Burks, Rantz, & Pomeroy, 2003; Conn, Valentine, & Cooper, 2002; King, Rejeski, & Buchner,1998; van der Bij, Laurant, & Wensing, 2002), including interventions designed to reduce falls (Gillespie et al., 2009; Sherrington et al., 2008). While these reviews provide relevant information on the strengths and limitations of current intervention approaches, additional evaluation of physical activity interventions targeting older adults at risk for falls is needed to identify intervention characteristics that may influence future research and translation of this body of research into practice (Glasgow & Emmons, 2007; Glasgow, Kleges, Dzewaltowski, Bull, & Estabrooks, 2004; Whittemore, 2009).

The following review was designed to evaluate the translation potential of physical activity interventions to reduce falls among older adults, including an analysis of (a) study design and intervention characteristics (theoretical

underpinnings, critical content); (b) reach and representativeness (sample); (c) efficacy/effectiveness (influence of the intervention on important outcomes); (d) adoption (proportion and representativeness of locations and interventionists adopting the intervention, social context); (e) intervention implementation (fidelity); and (f) maintenance (adherence, attrition, program sustainability). A secondary purpose was to provide recommendations for research and implications for practice based on this evaluation.

Literature review methods. Systematic computer searches were conducted in PsycINFO, PubMed, CINAHL, and the Cochrane Review databases to identify articles published in the English-language literature between January 2000 and January 2010. Keywords used included falls, accidental falls, fall prevention, physical activity intervention, and physical activity. Reference lists from relevant studies and resources were also reviewed. Community-based intervention and implementation studies were considered that (a) focused on community dwelling adults over the age of 60; (b) used physical activity interventions; (c) assessed physical activity behaviors, balance and strength, or fall occurrence as outcome variables; and (d) used quasi-experimental or randomized controlled trial methods. Studies targeting persons in the hospital or residing in long-term care settings were excluded.

The search yielded 407 titles and abstracts, 335 of which were irrelevant to review screening criteria. Seventy-two articles of relevance were read in detail after which another 26 articles were excluded as they focused on persons living in long term care settings (7) or acute care settings (3), duplicated reports of studies

already included in the review (5), did not include measures of fall risk, falls, or physical activity behavior (4), did not include physical activity content (1), were not available (1), intervention was disability based (2), reported a case study (1) or descriptive study (2). Thus, 46 studies met inclusion criteria and were analyzed for this review. Criteria-based checklists guided the appraisal of study designs, intervention characteristics, and the translation potential of fall-preventive physical activity interventions. Specific indicators included study design, theoretical underpinnings, intervention critical content (Fink, 2005), and RE-AIM dimensions (see Table 1) (Glasgow & Emmons, 2007; Glasgow et al., 2004; RE-AIM.org, 2011). A narrative synthesis was used to report and interpret the collected evidence, as variable intervention characteristics and descriptions prohibited quantitative analyses (Popay et al., 2006).

The coded variables were entered into SPSS (version 16.0) to facilitate descriptive analyses. Relationships among studies were explored by examining characteristics of individual studies and their reported findings. Robustness was assessed by reflecting on the synthesis process and engaging in ongoing dialogue about the synthesis methods, manuscripts chosen for the review, discrepancies identified, and identifying opportunities to build upon current literature to influence translation to practice (Popay et al., 2006). Results were organized using textual descriptions categorized as study design, intervention characteristics, and RE-AIM framework elements. Appendix A highlights study design characteristics and elements of the RE-AIM framework, Table 2 summarizes intervention characteristics, and Table 1 outlines RE-AIM framework dimensions

and percentage of studies reviewed that reported on specific indicators of each dimension (McMahon & Fleury, 2012a).

Table 1

RE-AIM Framework Dimensions and Indicators

RE-AIM Dimension Indicators by RE-AIM Dimension	Percentage of Studies Reviewed That Reported on Each RE-AIM Indicator
Reach	
Sample size	100%
Participant characteristics	100%
Description of the target population	98%
Selection criteria	95%
Participation rate	43%
Characteristics of non-participants	2%
Cost of recruitment	2%
Efficacy/effectiveness	
Behavioural outcome	24%
Primary outcome measures	100%
Primary outcome results	100%
Quality of life measures	22%
Cost effectiveness	4%
Critical inputs guided by theory	9%
Adverse outcomes	39%
Adoption	
Intervention setting and location	72%
Description of staff who delivered the intervention	82%
Method to identify target delivery agent	0%
Level of expertise of delivery agent	67%
Inclusion/Exclusion of settings or interventionists	6%
Cost of adoption	2%
Implementation	
Intervention type and delivery	100%
Critical input identification	100%
Number of contacts	100%
Timing of contacts	95%
Duration of contacts	76%
Intervention fidelity	11%
Participant attendance	69%

Table 1, continued.

RE-AIM Dimension Indicators by RE-AIM Dimension	Percentage of Studies Reviewed That Reported on Each RE-AIM Indicator
Completion rates	98%
Attrition analysis	42%
Implementation cost	9%
Maintenance	
Follow-up of at least 6 months	57%
Individual behaviour was described 6 months after the intervention	11%
Information on continued delivery	8%

Table 2

Proportion of Studies Reporting Specific Intervention Characteristics (N=46)

Intervention Delivery Mode (Frequency)	
Face-to-face	
Face-to-face combined with telephone calls	
Theoretically Based Interventions	
Theoretical basis for intervention specified	9%
Behavioural, Affective, and Cognitive Critical Content (majority of studies used more than one element)	
Education about falls and safety	44%
Encourage social support	24%
Enhance motivation for physical activity	14%
Individualize or tailor physical activities	20%
Promote fall or self-efficacy	13%
Promote self-regulation	17%
Provide resources for physical activities at home	31%
Physical Activity Critical Content (several studies used more than one element)	
Balance	82%
Endurance	42%
Flexibility	31%
Leg strengthening	82%
Tai Chi	11%
Other (e.g., dance, square step)	4%
Dose Details (Range, Median)	
Dose (number of intervention sessions)	(1 - 312) 15.5
Duration (of each session in minutes)	(15 - 120) 60
Time interval between each dose (in days)	(1 - 45) 3.5

Critical Content: Intervention elements essential for intervention effects.

Review results.

Study design and intervention characteristics. The selected studies tested interventions in controlled laboratory settings (82%) or community-based settings (18%) using experimental (76%) or quasi-experimental designs (24%). Four of the 46 intervention studies reviewed referenced a theoretical framework, including social cognitive theory (Hakim, Newton, Segal, & DuCette, 2003), the transtheoretical model (Greaney et al., 2008), the cognitive behavioral model (Healy et al., 2008), and the self-efficacy concept (Clemson et al., 2004). Greaney and colleagues (2008) evaluated intervention strategies tailored to stage of change, consistent with the transtheoretical model. Hakim and colleagues (2003) designed a study to determine the effectiveness of a fall risk reduction program, operationalizing social cognitive theory constructs of behavioral capability, expectations, expectancies, components of observational learning, and self-efficacy. Healy and colleagues (2008) examined the efficacy of coaches in assisting persons to reduce falls and their fear of falling, operationalizing cognitive behavioral model constructs of self-efficacy, goal setting, and knowledge.

A range of behavioral, affective, and cognitive critical content was identified in the studies reviewed, including (a) individualizing or tailoring physical activities; (b) providing education about falls, safety, and wellness; (c) encouraging social interaction; (d) enhancing motivation for adopting behavioral changes; (e) providing resources for home exercises; (f) promoting self-regulation; and (g) promoting fall efficacy or self-efficacy. Twenty percent

of the studies described individualizing the intervention in accordance with baseline physical assessment or individual pacing preferences. Inokuchi, Matsusaka, Hayashi, and Shindo (2007) described breaks built into intervention sessions to enhance socialization. One intervention encouraging social interaction reported improved perceptions of social support and physical activity behaviors among intervention group participants (Healy et al., 2008). Six studies employed strategies to enhance motivation using strategies such as setting goals. Two studies integrated technology into motivational critical content by providing participants with pedometers before starting the intervention to monitor their activity during the intervention (Dubbert, Cooper, Kirchner, Meydrech, & Bilbrew, 2002; Shigematsu et al., 2008). One of these reported increased motivational readiness and walking behaviors among intervention participants (Dubbert et al., 2002). While the remaining five studies did not measure motivation, positive outcomes including increased self-reported physical activity (Laforest et al., 2009), decreased fall occurrence, and decreased fall risk were observed in intervention groups (Campbell et al., 2005; Dubbert et al., 2002; Robertson, Devlin, Gardner, & Campbell, 2001; Robitaille et al., 2005). Intervention critical content was delivered through structured classes, phone calls, home visits, individualized pamphlets, and worksheets. Limited information about links between critical content, the problem being studied, mediating processes and outcomes made it difficult to evaluate which critical inputs fostered which intervention effects.

Intervention studies described approaches to physical activity promotion including instructions for progressively intensified activities intended to improve lower extremity strength and balance. Many studies also addressed flexibility and endurance. Various forms of Tai Chi were described and associated with decreased fall risk (Li et al., 2005; Lin, Hwang, Wang, Chang, & Wolf, 2006; Voukelatos, Cumming, Lord, & Rissel, 2007) and fall occurrence (Li et al., 2005; Voukelatos et al., 2007). Non-traditional strength and balance activities such as square stepping, jazz dancing, and walking were also effective in decreasing fall risk (Alpert et al., 2009; Dubbert et al., 2002; Shigematsu et al., 2008). Use of exercise aids such as ankle weights, resistance bands, and exercise balls were described in 24% of the studies reviewed.

***Reach and representativeness*.** The median sample size of studies reviewed was 198, ranging from 15 to 1,200. Participants were described in the majority of studies, though documentation of race and ethnicity, socioeconomic characteristics, and fall risk factors was variable. Of studies that described participant ethnicity or race, the proportion of African American study participants was less than 20% (Binder et al., 2002; Healy et al., 2008). Native Americans comprised approximately 10.5% in another study (Healy et al., 2008). The average age of participants ranged from 68 to 88 years (median 76 years); 51% to 95% were female across studies that included both genders. Six studies included only females and two included only males. Among studies reporting education levels, the majority of participants had a high school or college education. Healy and colleagues (2008) and Lin and colleagues (2006), however,

reported that 50.5% and 90% of their respective participants had education at the high school level or lower. Forty-two percent of studies recruited individuals with risk(s) of fall, specifying inclusion factors such as a history of falls, frailty, fear, sedentary lifestyles, and imbalance. The remaining 58% of studies either did not recruit older adults with specific risk factors or recruited those with other risks, such as osteoporosis.

Efficacy and effectiveness. Health, behavioral and psychosocial outcome measures varied across studies reviewed. Adverse event measures were described in 39% of studies. Outcome stratification based on participant characteristics and moderator analyses was performed in the minority of studies reviewed: 16% and 8% respectively. Fall occurrence reported in terms of incidence rates, incidence risk ratios, and mean differences was identified as primary or secondary outcomes in 71% of studies reviewed. Fall occurrence (e.g., incidence rates and incidence risk ratios) was reported in 70% of the studies reviewed; 59% of these reported statistically significant intervention effects (McMahon & Fleury, 2012a).

More than 30 types of physical function, balance, and strength measurements were reported as indicators of fall risk in 87% of the studies reviewed. Seventy-five percent reported statistically significant improvements in at least one of these measures; others reported mixed effects. Hakim et al. (2003) documented significant improvements in forward reach among intervention group participants, but not in Berg Balance Scale scores or in the Timed Up and Go test. Steadman, Donaldson, and Kalra (2003) found significant decreases in fall risk among both intervention and control group participants. Helbostad, Sletvold, and

Moe-Nilssen (2004) found equivalent results between groups that received traditional physiotherapy and physiotherapy plus instruction on home strength and balance exercises. However, the sample size in their study (n=77) may not have been large enough to detect significant group differences. Two studies (Fukukawa et al., 2008; Greaney et al., 2008) reported no significant effect on fall risk among intervention participants for reasons that may relate to intervention frequency and intensity. Latham and colleagues (2003) reported no significant intervention effects on fall occurrence or risk, to which they attributed promoting only quadriceps exercises and limited intervention duration.

In addition to measuring the occurrence and risk of falls, physical activity behaviors were examined in the minority of studies reviewed. Physical activity behavior was measured objectively in two studies using pedometers (Dubbert et al., 2002; Shigematsu et al., 2008). Significant increases in steps were reported in treatment groups (Dubbert et al., 2002) and a control group that emphasized walking (Shigematsu et al., 2008). Physical activity was measured subjectively in 10 studies. Results varied and were not always congruent with other study outcomes. For example, Barnett, Smith, Lord, Williams, and Balmand (2003) found that intervention participants experienced decreased falls, decreased risk, and improved coordination, yet they found no group differences in self-reported physical activity behaviors. Hauer, Lamb, Jorstad, Todd, and Becker (2006) found that self-reported physical activity behaviors, walking velocity, and balance improved, but fall occurrence did not significantly change. In a study comparing resistance training to agility and flexibility training, fall risk factors decreased

most significantly among those in the resistance and agility training groups, but self-reported measures of physical activity behaviors were similar across groups (Liu-Ambrose et al., 2005).

Psychosocial outcomes in studies reviewed included measures for depression, fear of falling, motivation, and social support. The Geriatric Depression Scale was used to measure depression (Alpert et al., 2009; Inokuchi et al., 2007; Vogler, Sherrington, Ogle, & Lord, 2009). To estimate fear of falling, studies used a variety of instruments: the Balance Self-Confidence Scale (Robitaille et al., 2005), Falls Self-Efficacy Scale (Clemson et al., 2004, Fukukawa et al., 2008; Greaney et al., 2008; Healy et al., 2008; Logghe et al., 2009; Nitz & Choy, 2004), the Modified Falls Efficacy Scale (Clemson et al., 2004; Day et al, 2002; Latham et al., 2003; Vogler et al., 2009), the Mobility Efficacy Scale (Clemson et al., 2004), the Survey of Activities and Fear of Falling in the Elderly Scale (Li et al., 2005), a 10 cm visual analog scale for rating the severity of fear of falling (Lin et al., 2006; Lin, Wolf, Hwang, Gong, & Chen, 2007; Weerdestyn, Smulders, Rijken, & Durysens, 2009), the Falls Control Scale (Healy et al., 2008), the Falls Management Scale (Healy et al., 2008), and the Activities Specific Balance Scale (Haines et al., 2009; Hakim et al., 2003). One study measured motivation using the exercise stages of change (Dubbert et al., 2002). Four studies measured social support using the perceived Social Support of Exercise Scale (Dubbert et al., 2002), investigator-developed one (Greaney et al., 2008), and five-item scales (Fukukawa et al., 2008), and a falls handicap inventory (Steadman et al., 2003).

Outcomes indicating intervention effects on quality of life and cost were reported infrequently. Of the four studies that measured quality of life, one reported significant intervention effects (Ashburn et al., 2007; Carter et al., 2002; Dubbert et al., 2002; Haines et al., 2009). Haines and colleagues (2009) reported no effects on fall rates, quality of life, fear, or physical activity following education and demonstration of "kitchen table" balance and strengthening exercises to persons at risk for falling following hospital discharge. This may be due to intervention dosing or a small sample size (n=53). Robertson and colleagues (2001) reported cost savings from a nurse-delivered exercise prescription to frail older adults in their homes. Hakim and colleagues (2003) calculated the cost of a community-based program as approximately $14.87 per participant. Carter and colleagues (2002) calculated that a 20-week program for 48 participants cost $4,800.

Adoption. The majority of studies reviewed identified settings and levels of interventionist expertise. Countries represented were Australia, Canada, China, Germany, Japan, New Zealand, the Netherlands, Taiwan, the United Kingdom, and the United States. Two studies (DiBrezzo, Shadden, Raybon, & Powers, 2005; Lin et al., 2006) were conducted in rural locations. Sites for group-based interventions were identified as senior community centers, community centers, retirement communities, indoor health facilities, and rehabilitation facilities. Multiple community and clinical settings were also used; in one study orthopedic surgeons promoted the adoption and maintenance of two simple daily exercises by clients of more than 60 clinics (Kita et al., 2007). Another study examined the

effects of Tai Chi in several rural Taiwan villages (Lin et al., 2006). Eighty-three percent of the studies reviewed specified interventionist characteristics and expertise (see Appendix A), indicating that community volunteers, nurses, occupational therapists, physicians, physical therapists (or physiotherapists), physical therapy aides or technicians, and Tai Chi instructors all delivered interventions. The majority of studies reviewed did not describe details about inclusion/exclusion criteria for setting or interventionist selection, or details enough to calculate adoption rates.

***Implementation*.** Interventions occurred in sessions lasting from 15 to 120 minutes at intervals ranging from one to 45 days. Intervention dose among studies reviewed ranged from one to 315 contacts with a median dose of approximately 15.5 contacts. Contacts are defined as face-to-face sessions or telephone contacts.

Measures of intervention fidelity were explicitly described in four studies (Healy et al., 2008; Laforest et al., 2009; Robertson et al., 2001; Robitaille et al., 2005). Interventionists underwent at least two to five days of training using formal instruction and had access to well-developed training manuals and experts (Healy et al., 2008; Laforest et al., 2009; Robertson et al., 2001; Robitaille et al., 2005). Additional studies (53%) indicated that interventionists were trained, but did not specify training methods or targeted competencies. Healy and colleagues (2008) integrated fidelity monitoring measures based on the five-component model developed by the behavioral change consortium (Bellg et al., 2004). Haines and colleagues (2009) integrated systems for participants to discuss their

intervention experiences with interviewers who were not interventionists. Steadman and colleagues (2003) measured intervention integrity through an independent observer's evaluation of intervention group sessions.

***Maintenance*.** Studies reviewed described the extent to which participants made and maintained behavior change measured as intervention adherence and long-term follow-up. Adherence was described in 85% of studies reviewed, but varying methodologies prohibited direct comparison. Self-reports of session attendance or engagement in intervention recommendations at home, were obtained via calendars, diaries, or interviews. Some group-based intervention studies kept attendance records; adherence rates ranged from 18% to 100%, averaging approximately 70%. Rationale for participant non-adherence, described in one study, was linked to loss of interest, inconvenient intervention timing, and illness (Voukelatos et al., 2007). Positive intervention effects were reported among participants with varied attendance rates, making the minimal effective dose unclear. Follow-up outcomes measured at least six months after intervention completion were reported in 50% of the studies reviewed.

Descriptions of study attrition rates and comparative analyses were respectively reported in 98% and 42% of the studies reviewed. Attrition rates ranged from 1% to 60%. Several reports grouped attrition rationale into broad categories including illness, lack of transportation or motivation, relocation to a nursing home, death, inconvenient schedules, and intervention non-adherence. Comparisons of participants who withdrew from studies to those who completed studies produced varied results. Several studies reported no significant group

differences in demographic characteristics, fall history, or physical function (Hakim et al., 2003; Healy et al., 2008; Li et al., 2005; Nitz & Choy, 2004); others reported significant group differences. Compared to participants who completed the study, participants not completing studies tended to be male (Morgan, Virnig, Duque, abdel-Moty, & DeVito, 2004); widowed, divorced, or single (Lin et al., 2007); older (Fukukawa et al., 2008); taking more medications (Morgan et al., 2004); weaker, less active, or less physically functional (Day et al., 2002; Means & O'Sullivan, 2005; Morgan et al., 2004); or having lower maximal oxygen consumption rates (Day et al., 2002).

Several of the intervention studies described programs that have been sustained through continued use, dissemination, and evaluation (Campbell et al., 2005; Clemson et al., 2004; Healy et al., 2008; Laforest et al., 2009; Li et al., 2005; Skelton, Dinan, Campbell, & Rutherford, 2005; Weerdestyn et al., 2009). For example, Stepping On, used in one study (Clemson et al., 2004), is being implemented and evaluated in various Wisconsin communities (CDC, 2009a; Wisconsin Department of Health Services, 2011). A Matter of Balance is designed to reduce fear of falling while promoting leg strengthening and balance exercises, and is being evaluated in at least 10 states (CDC, 2009a; Healy et al., 2008). The Nijmegen Falls Prevention Program has been disseminated to many physiotherapists in the Netherlands (Weerdestyn et al., 2009).

Summary of strengths and limitations. This review provides a starting point for identifying practice implications and recommendations for future research. The majority of studies reviewed were randomized controlled trials

based on biomechanical and kinesiology principles of physical activity. Few studies specified theoretical perspectives to guide intervention implementation and evaluation. Three of the four studies that included theoretical frameworks provided limited detail linking theory to intervention operationalization. The advantages of theory-based interventions include increased understanding of relevant problems, a conceptual guide for intervention development and implementation, modeling mechanisms of underlying intervention effectiveness, and defining systematic evaluation (Lipsey, 1993; Lipsey & Cordray, 2000; Sidani & Braden, 1998).

Physical activity intervention elements were described including details relevant to content, dose, and delivery. The majority of interventions that promoted the practice of Tai Chi and traditional multi-component leg strengthening and balance exercises at least two times weekly reduced fall risk and fall rates. These findings are consistent with previous reviews that have documented significant effects for multi-component physical activity interventions and Tai Chi (Gillespie et al., 2009). In addition to traditional strength and balance exercises such as side leg raises, knee curls, toe stands, and one-leg stands, researchers examined the efficacy of other activities that naturally integrate these movements. For example, square stepping improved leg power and balance (Shigematsu et al., 2008), and regular practice of jazz dance improved balance (Alpert et al., 2009). While the physical activities identified in this review are safe to individualize and use for persons across all older adult age groups and conditions, the primary focus on physical activity dose-response goals

do not improve understanding of the motivational resources required to maintain physical activity gains in "real world" settings (Brawley et al., 2003). Critical content combined with physical activities were varied and addressed cognitive, behavioral, and affective change.

The majority of studies addressing cognitive, behavioral, and affective critical content reported positive outcomes, but few provided detail about operationalizing critical content. While many studies focused on education, encouraging social interaction, and providing resources, few measured associated mechanisms such as knowledge, perceived social support, or resources. In addition to understanding which physical activities, at which doses, best reduce falls, better understanding of which critical content is necessary and sufficient to influence physical activity behaviors will help clinicians to promote these interventions in practice (Pawson, Greenhalgh, Harvey, & Walshe, 2005; Sidani & Braden, 1998; van Stralen, DeVries, Muddle, Bolman, & Lechner, 2009).

Studies reviewed included populations ranging from asymptomatic older adults to those with co-existing chronic conditions and fall risk. Few studies addressed rural dwelling older adults, or those with lower levels of education or socioeconomic status. Fall prevention intervention research that integrates multilevel strategies for countering sociocultural forces negating physical activity recommendations among older adults would provide a beginning mechanism to examine intervention effects on factors that compete with or block fall-preventive physical activity recommendations (Brawley et al., 2003). To reduce health disparities and provide a basis for the development of relevant interventions,

research efforts must better reflect the needs of diverse older persons in their community contexts. Successful intervention design requires an integrative understanding of the unique cultural and contextual perspectives, characteristics, and resources of the target population, as well as the theoretically relevant determinants of behavior that can be transformed into relevant behavior change strategies (Fleury & Lee, 2006).

All of the studies reviewed reported health related outcomes of interventions such as fall occurrence and risk. Few studies examined intermediate outcomes or reported behavioral outcomes. Clear links between outcomes and mediating processes (intermediate outcomes) that reflect treatment response to a well specified problem of interest will better explain intervention effects, and thus generate additional knowledge to guide practice (Whittemore & Grey, 2002). As most older adults are physically inactive and do not engage in leg strengthening and balance activities on a regular basis (CDC, 2009b), understanding the behavioral outcomes of interventions designed to reduce falls will help researchers and clinicians further intervention development, use, and adaptation. Knowledge of which physical activities work at which doses and frequencies is essential, yet does not answer questions about factors influencing decisions and actions of older adults related to the adoption, initiation, and maintenance of habits that integrate physical activities into their lifestyles. Prescribed recommendations for fall-preventive physical activities appear simple, but interacting complexities emerge with implementation (van Stralen et al., 2009). For example, when considering prescribed activities, older adults are faced with

(a) unique and variable barriers to being active; (b) complex physical activity recommendations necessary for the generation of outcomes (e.g., reduction of falls); and (c) the complexity of behavioral and lifestyle change as a strategy to maintain or regain independence (Brawley et al., 2003).

Physical activity interventions in other fields have integrated objective measures of physical activity as a way to examine intervention effects on behavioral change. Additionally, researchers have developed persuasive technologies (Fogg, 2003) that may be integrated into interventions promoting behavioral change (Hekler et al., 2012b; King et al., 2012; Winter et al., 2012). Continued development of technological approaches to accurately measure of physical activity behavior and augment critical content of interventions that integrate behavioral change will improve the ability of researchers and clinicians to promote and evaluate interventions in practice settings among diverse populations who have varied causes of decreased engagement in fall-preventive physical activities.

Similar to findings in a recent meta-analysis (Gillespie et al., 2009), this review noted that physical activities delivered by interventionists either individually or in groups were effective in community-based and home settings. Interventions reviewed employed varying professional interventionists, physical activity and Tai Chi instructors, and community volunteers, demonstrating the potential for interdisciplinary collaboration in this field. This review also included effectiveness studies carried out in multiple community and clinic settings. These findings suggest the implementation of physical activity

interventions in homes, community-based settings, and settings outside highly controlled environments are all feasible. Beyond the identification of intervention setting and interventionist level of expertise, reporting additional adoption indicators such as setting and interventionist inclusion/exclusion criteria, adoption rates, and organizational spread would provide meaningful information about intervention applicability in different settings by different interventionists (Akers, Estabrooks, & Dave, 2010).

All studies reviewed described the intensity, frequency, and duration of interventions tested, yet few described if interventions were implemented consistently or as intended. Based on information provided by studies reviewed, it would be difficult to replicate interventions due to limited detail about intervention delivery. Implementing, evaluating, and adapting these interventions in research and practice could be fostered with detailed descriptions of interventionist competencies and implementation procedures necessary for each intervention (Bellg et al., 2004).

Measures used to assess participant adoption, initiation, maintenance, and acceptance of recommended activities were limited to adherence. Varying definitions and levels of adherence across studies raise questions about effective dose, as well as which intervention elements promote physical activity that reduces falls in "real life" settings. Researchers examining older persons' views about fall-preventive activities report they are motivated by easily accessible small classes composed of similarly aged people, emphasizing mobility and balance, and led by instructors capable of providing guidance for individualized

progression (Hutton et al., 2009). Older adults also have preferences for programs that respect individual goals, promote social interaction, and focus on life enhancing aspects of fall-preventive behaviors, while avoiding negative messages (Bunn, Dickinson, Barnett-Page, McInnes, & Horton, 2008; McInnes & Askie, 2004; McMahon, Talley & Wyman, 2011). Synthesizing knowledge of participant perspectives, clinical knowledge, and scientific knowledge will promote a comprehensive approach to intervention development and translation (Whittemore & Grey, 2002).

In conclusion, the development of physical activity interventions that reduce the risk and occurrence of falls has been identified as critically important for achieving global health objectives and for reducing healthcare costs. Research analyzed in this review suggests that the body of knowledge regarding physical activity interventions to prevent falls is rapidly expanding. Research to date has documented that regular engagement in leg strengthening and balance activities decrease the risk and occurrence of falls among community dwelling older adults. While interventions designed to reduce the occurrence and risk of falls clearly link physical activities with positive outcomes, they do not yet reflect the complexity of human responses to fall risk, the complexity of diverse practice settings, and the relational elements in health promotion interventions (Whittemore & Grey, 2002). Addressing issues related to intervention characteristics and the RE-AIM framework in future research will foster the translation of this research into practice. Additional programmatic research is needed that (a) targets diverse populations, including older adults at high risk for

falls and rural dwelling older adults; (b) incorporates and tests theoretical perspectives; (c) operationalizes intervention critical content to foster replication and translation; (d) explores innovative measures for physical activity behavior; and (e) evaluates the feasibility of falls prevention interventions in older adults.

Specific Research Aims

This feasibility study evaluates the acceptability, demand, implementation, and efficacy of a theory-based motivational intervention to promote physical activity for fall prevention among older adults. The wellness motivation theory (WMT) provides a theoretical basis for the wellness motivation intervention (WMI) to operationalize the relationships between social contextual resources and behavioral change processes to facilitate the creation and maintenance of supportive personal and ecological environments that promote physical activity behaviors known to reduce fall risk.

- **Specific Aim 1**. Examine the acceptability, demand, and implementation of the WMI among rural community dwelling older adults.
    - **1a**. What is the acceptability of the intervention in older adults as measured by participant evaluation of the intervention protocol (intervention components, mode of delivery) and the acceptability and usability of new technology used to augment the delivery of the WMI critical content?

- **1b**. What is the demand of the intervention in older adults as evaluated by measurement of participant attrition rates and attendance to intervention sessions?
- **1c**. What is the implementation fidelity of the WMI as evaluated by the Index of Procedural Consistency and external expert review?

- **Specific Aim 2**. Evaluate the effects of the WMI in increasing social contextual resources, behavioral change process variables, the behavioral outcome of engaging in physical activity, and the health outcome of fall risk reduction among rural community dwelling older adults.
  - **2a**. Intervention participants will demonstrate a significant increase in social contextual resources (social support, perceived environmental resources) and behavioral change process variables (self-knowledge, motivation appraisal, self-regulation) compared with an attention control group.
  - **2b**. Intervention participants will demonstrate a significant increase in intensity, frequency, and duration of regular physical activity on subjective self-report measures and objective accelerometer data, compared with an attention control group.
  - **2c**. Intervention participants will demonstrate a significant improvement in the health outcome of reduced fall risk

measured as functional strength and balance compared with an attention control group.

Significance of the research. This research supports the work of state and national public health and policy organizations. It is consistent with the National Institute of Nursing Research goals of identifying and developing interventions designed to promote the maintenance of healthy behaviors over time among vulnerable or underserved groups, such as older adults and those living in rural settings (National Institutes of Nursing Research, 2011). The Minnesota Department of Health (2007) emphasizes fall prevention through their statewide initiative. Additionally, the Healthy People 2020 initiative includes a goal targeting improved health (e.g., injury prevention), function, and quality of life among older adults and a specific objective of increasing the proportion of older adults who engage in leisure time physical activity (DHHS, 2011a).

Older community dwelling adults have lower levels of physical activity and higher levels of fall risk compared to other populations. Although it is clear that a variety of physical activities reduce fall risk and occurrence, effective methods to promote motivation for these behaviors in diverse older adult populations are not yet established. Fall prevention interventions focusing on physical activity dose-response have demonstrated the efficacy of leg strengthening and balance activities to reduce the risk and occurrence of falls among older adults (Gillespie et al., 2009). The majority of research has been based on biomechanic and kinesiology principles, thereby supporting which physical movements build strength and balance at which doses. Few intervention

studies have addressed motivation on the part of older adults to engage in recommended physical activities known to reduce fall risk (McMahon & Fleury, 2012a). Many older adults understand that falls are a risk to their health and well-being, but knowledge of risk may not motivate the adoption and maintenance of physical activities to reduce risk (Bunn et al., 2008; McMahon et al., 2011; Yardley, Donovan-Hall, Francis, & Todd, 2007). This research provides a theoretical basis for testing an intervention addressing motivation for behavioral change while also promoting physical activity behaviors proven to reduce fall risk. Integrating specific intervention elements designed to promote the use of social and environmental resources will facilitate intervention replication in diverse research and clinical settings (Glasgow, Lichtenstein, & Marcus, 2003).

Relevance to nursing science. Nursing science, particularly intervention research focused on falls prevention through physical activity, has been influenced by traditional cognitive models and theories, including the health promotion model (HPM), self-efficacy theory, and the transtheoretical model (TTM). These theories have emerged from traditional cognitive psychological schools of thought emphasizing the role of individual expectations in behavior prediction (Heckhausen, Schultz, & Wrosch, 2000), and assume health behavior change as a linear event consistent with particulate-deterministic and interactive-integrative worldviews (Fawcett, 1993; Glanz, Rimer, & Viswanath, 2008). The WMT, congruent with a unitary-transformative worldview (Fawcett, 1993, 2005), adds to nursing science in falls prevention by employing theory-based

intervention testing that is congruent with contemporary philosophies of science such as intermodernism (Reed, 1995, 2006, 2011).

Specific to the study of motivation, worldviews reflected in traditional cognitive theories do not emphasize the patterning of human behavior in mutual process with the environment, including the influence of factors that may prohibit the individual from initiating and maintaining behavior change over time. For example, particulate-deterministic worldviews assume that humans are the sum of the bio-psycho-social-spiritual components, and that they react to their environments in a linear fashion—change is predictable, occurring in response to survival needs (Fawcett, 2005). This worldview is congruent with positivistic philosophy of science whereby knowledge and truth are derived only from those things that are observable, measurable, and well defined (Fawcett, 2005; Reed, 2006; Whallen & Hicks, 2002). Interactive-integrative worldviews see humans as holistic and not reducible. Humans reciprocally interact with the environment, changing in predictable ways (Fawcett, 1993). This is congruent with post-positivistic philosophy of science, whereby diverse forms of inquiry are seen as valuable, but are "objectivist in nature, reductionist in intent and deterministic in focus" (Powers & Knapp, 2006, p. 133).

Traditional theories assume that motivation for behavior change arises from perceived susceptibility or severity of illness, implying that motivational processes are triggered by perceived deficits. As a result, this assumption leads to a conceptualization of motivation as a function of tension (e.g., threat or potential loss) (Heckhausen et al., 2000). Deficit-based views of motivational processes

limit the development and operationalization of strength-based theories and approaches where there is a focus on personal values and growth. While nursing (or intervening) is integral to human-environment processes (Reed, 1997; Sidani & Braden, 1998), traditional cognitive theories imply that individual behavior occurs as a mechanistic response to information prescribed or received. From a practice perspective, mechanistic conceptualizations of nursing as external actions (e.g., prescriptions) to clients, taken by nurses, do not effect change (Fleury, 1991).

Unitary-transformative worldviews emphasize personal knowledge and pattern recognition. Humans are unitary and continually change, moving through stages of organization and disorganization and evolving as self-organized fields (Fawcett, 1993). Pattern recognition and personal becoming are the primary phenomena of interest (Fawcett, 1993; Reed, 1995, 2011). Unitary-transformational worldviews are consistent with an intermodernism philosophy of science (Reed, 2011). Intermodernism builds upon ideas at the intersections of modernism and postmodernism, urging contemporary theories to concentrate on human developmental potential of well-being and supporting knowledge generation from a synthesis of practice, theory, and research (Reed, 2006, 2011; Whallen & Hicks, 2002). Intermodernism supports experimentation, creativity, and critical thinking as well as ambiguity, maintaining an open-ended view of nature together with skepticism, while rejecting dogmatic views of truth (Reed, 2006, 2011). Its tenets include (a) new empiricism encompassing new and varied techniques; (b) a new epistemology where clinicians are educated to produce

knowledge in practice; (c) critical realism that embraces a diverse repertoire of human experiences; (d) a value for differences with concern for oppression; (e) an assumption of shared principles, individual differences, and local truths; and (f) a value for ongoing critique keeping metanarratives, theories, and philosophies open, dynamic, and contextually relevant (Reed, 2006, 2011). Ontological perspectives congruent with unitary-transformational worldviews and epistemological perspectives congruent with intermodernism are foundational to assumptions underlying the WMT.

Parse (1988) suggests that individuals create a personal significance by choosing options from various realms, as speaking and moving uncover the imagined self, thus knowing through a frame of reference of the individual's own values and priorities. Empowering potential, the overarching construct guiding the WMT, reflects a process of individual growth and development that enhances the emergence of new and positive health patterns, consistent with an individual's values and goals (Fleury, 1996). Interventions designed to foster motivation in the WMT use relational nursing processes focusing on values that are meaningful to the individual and consistent with individual social contextual resources (e.g., environmental, social, and biological). Relational processes shift from focusing on antecedents or determinants of motivation, to motivational processes and the patterning and evolution of human motives for behavior in mutual process with the environment (Arslanian-Engoren, Hicks, Whall, & Algase, 2005). The WMI is part of human-environmental processes in which individuals uncover meanings in light of personal values (Mitchell, 1988; Parse, 1988). The WMT provides a

foundation for nursing and other interventionists to facilitate individual exploration of values, dreams, and goals with awareness and sensitivity to social contextual factors.

Summary

In conclusion, the development of physical activity interventions that reduce the risk and occurrence of falls has been identified as critically important for achieving global health objectives and for reducing healthcare costs. Themes in nursing focusing on healing environments, inner human potential, and the developmental-contextual nature of health (Reed, 1995), in combination with nursing research priorities emphasizing health promotion (DHHS, 2011b), suggest that the continued generation of knowledge needed to prevent falls among older adults is priority. The body of knowledge regarding fall prevention interventions is rapidly expanding. The WMI operationalizes the WMT, providing guidance for implementation and evaluation in rural, community-dwelling older adults at risk for falls. As a first step in a program of research, this feasibility study will examine the acceptability, demand, implementation, fidelity, and efficacy of the WMI in older adults who are sedentary and thus at risk of falling.

Chapter 2

THEORETICAL FRAMEWORK

The WMT was chosen to guide this research study as it is grounded in nursing science and acknowledges the complexity and contextual dependence of motivation for health related behavior change. This chapter provides an overview of WMT; underlying assumptions and theoretical constructs guiding the WMI. Prior to describing the elements of the WMI, the design and pilot testing of Ready~Steady, an iPod touch® application (app) developed to augment WMI critical content and measure physical activity is described. The theoretical approach to the WMI is described beginning with the theory of the problem in this study followed by intervention critical content, theoretical mechanisms, and expected outcomes (Lipsey, 1993; Sidani & Braden, 1998). Potential extraneous factors and implementation issues of the WMI in this study are also highlighted.

Theoretical Framework

The majority of fall prevention interventions have addressed the general problem of leg weakness and imbalance associated with fall risk, but few have addressed motivation to engage in physical activities that reduce fall risk. Motivation for health related behaviors is a complex phenomenon influenced by factors that change over time and across situations. Using a theory-based intervention that specifically addresses the problem of decreased motivation for fall-preventive physical activity may strengthen the ability to make explicit the nature and details of change (Lipsey, 1993). Advantages to theory-based approaches include (a) conceptual support for refining and improving

interventions; (b) a research framework within which questions about targeted participants and measures can be specified; (c) reduced error due to variance, creating greater likelihood of detecting treatment effects and results that are interpretable and generalizable; and (d) knowledge about interconnected concepts that give meaning to relevant related events (Lipsey, 1993).

Research targeting physical activity in older adult populations suggests that motivation for engaging in these behaviors is complex and contextually dependent. Motivational factors such as self-systems, self-regulation, and readiness have been identified in research examining correlates, benefits, and barriers of physical activity initiation and maintenance among older adults (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Cheung et al., 2007; Fleury & Sedikides, 2007; Wallace & Lahti, 2005). Motivation is central to the initiation and maintenance of physical activity behaviors, yet few physical activity interventions in the field of falls prevention have focused on motivational factors, and few have been based on theoretical models designed to promote motivation for behavioral change.

Wellness motivation theory. The WMI is guided by the WMT, a middle range nursing theory that focuses on wellness as a way of fostering individual growth in a manner consistent with achieving personal goals for behavioral change (Fleury, 1991, 1996). The WMT builds upon traditional motivational and behavioral theories by addressing how people develop goals for health behavior change, how they imagine opportunities for action, and how they create strategies for initiating and maintaining behavioral change (Fleury, 1996). Assumptions

underlying the WMT relate to humans, change, motivation, wellness, and nursing. Assumptions related to human beings include:

1. Human beings are individuals and members of communities, families, and various other groups who have unique interests 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 process 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 change include (a) the decisional processes that guide behavioral change relies on awareness and knowledge of culture, social context, and personal values; and (b) behavioral change is a process of intention formation and value directed activity that guides the creation of healthy goals and patterns. Assumptions related to motivation include that (a) motivation is more than a static trait or state and is more than a reaction to environmental changes; (b) behavior is motivated, not for the sole purpose of addressing a deficit, but to serve as a path for personally meaningful growth and change (Fleury, 1991, 1996); and (c) motivation is a complex and dynamic process that includes individuals moving beyond the present moment toward goals and dreams (Mitchell, 1988). Assumptions related to wellness include: (a) wellness is a purposeful process of individual growth, integration of experience, and

meaningful connection with others, reflecting personally valued goals and strengths, and resulting in being well and living values (McMahon & Fleury, 2012b), and (b) wellness co-exists across all functional and health statuses—it is not a process that can be prescribed. Assumptions related to nursing include that nurses and health care professionals engage with individuals to facilitate the clarification of personal values, meaning, priorities, and resources to make and live valued choices. In so doing, they co-transcend or mobilize new ways of living and transforming self that integrate and reach beyond old ways (Parse 1988).

In the WMT, motivation is conceptualized as individuals in mutual process with their environments. The primary focus in the WMT is on growth motivated behavior based on dynamic personal values (Fleury, 1996; Parse, 1988). These conceptualizations and assumptions move the WMT beyond a focus on attribution, cognition, and stages of change seen with traditional theories of motivation and behavioral change (Conner & Norman, 2005; Eccles & Wigfield, 2002). The three primary constructs in the WMT include (a) social contextual resources, (b) behavioral change processes, and (c) action. The WMT assumes that social contextual resources and behavioral change processes mutually influence health related action (Fleury, 1996).

Social contextual resources. Social contextual resources originate within individuals or as part of the sociocultural and physical environments. Social contextual resources have a significant impact on behavioral change processes, as well as physical activity initiation and maintenance. Examples of social

contextual factors that contribute to the problem of decreased motivation for fall-preventive physical activity include (a) limited resources or unsafe environments for physical activity, (b) having friends and family encouraging older adults to take it easy (WHO, 2007), (c) being embarrassed to be physical active or of appearing to be at risk for falling (Yardley & Smith, 2002), and (d) having limited social support from family and friends to engage in physical activities (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). Additionally, biological changes such as the presence of muscle weakness, gait changes, imbalance, pain, and chronic conditions influence individual social interactions, motivation for physical activity, and fall risk (Booth et al., 2000; King et al., 1998; Schutzer & Graves, 2004).

Social norms and culturally driven expectations influence how people view older adults, falls, and physical activity. Some societies view falls as an inevitable aspect of aging and maintain beliefs that older people are meant to, or deserve to, rest (WHO, 2007). Depending on family dynamics, adult children of older adults at risk of falls may exert authority and, in certain situations, restrict or over-protect their parents (Kilian, Salmoni, Ward-Griffin, & Kloseck, 2008). Older adults, considered a vulnerable population, have expressed concerns that organizational information about falls and being labeled a faller can be socially stigmatizing (Speed, Skelton, & Todd, 2009; Yardley et al., 2007).

Environmental resources such as access to information about preventability of falls and encouragement from healthcare providers influence the motivation for fall-preventive behaviors (Beaudreau, 2006; Booth et al., 2000;

McInnes & Askie, 2004; Schutzer & Graves, 2004; Trost, Owen, Bauman, Sallis, & Brown, 2002). An estimated 50% of reported falls occur inside home environments on level ground (WHO, 2007). Although it remains unclear which characteristics of the physical environment (e.g., poor lighting, slippery surfaces) contribute the most to falls, researchers agree that there physical environmental hazards and individual physical abilities are interrelated (Lord et al., 2007; Todd et al., 2008). Researchers also describe the positive influence that safe and crime-free neighborhoods have on increased physical activity (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; CDC, 2009b).

Community resources used to support behavioral changes, including physical activity, have been recognized as essential in promoting public health as well as in the diffusion of health care innovations. These resources acknowledge the importance of community connections to community members by providing services and opportunities that facilitate risk reduction (Minkler, 2000; Minkler & Wallerstein, 2003). Community resources such as low-cost alternative places to engage in physical activity have been found to be effective among low-income minority women (Dutton et al., 2007). Other community level factors that influence intention, decisions, volition, and independent action include transportation and living in areas where there is limited or no access to fall prevention programs (Evron, Schultz-Larsen, & Fristrup, 2009; Hutton et al., 2009; Roe et al., 2008; Snodgrass & Rivett, 2005). Social contextual resources may be operationalized in the WMI by raising awareness of individual, interpersonal, environmental, and community resources.

***Behavioral change processes*.** Behavioral change processes reflect ways in which individuals create and evaluate goals, establish standards and strategies for behavioral change, and regulate and strengthen patterns that result in behavioral change. In the WMT, behavioral change processes include self-knowledge, motivation appraisal, and self-regulation. They reflect the propensity to strive toward new goals and move beyond goals that have been achieved. Research targeting the correlates of moderate-intensity physical activity in older adults has identified motivational factors including self-systems, readiness, and self-regulation as important to physical activity initiation and maintenance.

Self-knowledge. Self-knowledge provides a context for meaning through which individuals interpret new information and establish goals and self-regulation strategies while acknowledging hopes and fears about future health and gauging self-efficacy (Fleury, 1996; Fleury & Sedikides, 2007). Fleury and Sedikides (2007) identified three processes of self-knowledge, including (a) representational processes encompassing socially created, desired, and feared selves; (b) evaluative processes encompassing goal expectations, potential for growth, and self-efficacy; and (c) behavioral action encompassing the creation of action plans, negotiating social contexts, and self-regulating. Older adults may believe messages that falls are inevitable and exercise creates risk (WHO, 2007). They may not believe there is potential for growth or development; or they may believe that muscle weakness leading to falls is inevitable. They may have a fear of falling (Yardley et al., 2007), a lack confidence about being active (Booth et al., 2000; Cheung et al., 2007; Wallace & Lahti, 2005) or a fear of vulnerability

(McMahon et al., 2011). Self-knowledge may be operationalized in the WMI though exploration of representational processes, evaluative processes, and behavioral action.

Motivation appraisal. Readiness to initiate behavioral change involves motivation appraisal as intention formation for goal directed behavior related to personal beliefs and values, information, resources, and goals (Fleury, 1991, 1996). Older adults may not have linked their health behaviors to their personal goals of maintaining roles, health of family, or caring for oneself as a means of optimizing independence (Fleury, 1997). They may identify barriers without analyzing why those are and how they might be overcome. Among older adults, motivation appraisal might be operationalized through analyzing concerns about physical activities proven to reduce fall risk, exploring ways to overcome problems that create barriers, and linking personal beliefs, values, and resources to personal goals, and the development of skills to achieve valued goals.

Self-regulation. Self-regulation transforms goal intentions into personalized action through cognitive, affective, and behavior strategies consistent with valued goals. The pursuit and attainment of self-generated goals and the maintenance of self-determined standards for behavior are critical sources of motivation that involve the internal regulation of behavior. Self-regulation guides individuals in goal-directed behaviors through selective processing of information, behavioral monitoring, judging individual performance, and engaging in self-evaluation (Bellg, 2003; Maes & Karoly, 2005). Self-regulatory mechanisms are key to understanding volitional aspects of behavior change in that

they reflect the ways in which people attempt to behave in accordance with personally valued goals, particularly when goals conflict or lead to different rewards over time. Self-regulation has been used to describe and predict adherence to cardiovascular risk reducing behaviors in older adults, including performance of regular physical activity (Anderson, Wojcik, Winett, & Williams, 2006; Bandura, 2004; Hallam & Petosa, 2004; Petosa, Suminski, & Hortz, 2003). Older adults may not monitor their behavior or compare their behaviors with their own valued goals, such as personal satisfaction and development (Fleury, 1996; Umstattd, Saunders, Wilcox, Valois, & Dowda, 2006; van der Bij et al., 2002). They may need additional social skills for how to deal with overprotective others who restrict activities of older adults (Brawley et al., 2003). Recognition of self-regulatory skills is essential because long-term adherence to behavioral change requires strategies for continued motivation and response to social contextual influences. Self-regulation may be operationalized through problem-solving strategies specific to individual concerns, self-monitoring, developing resources central to goal achievement, planning for and evaluating responses to social contextual changes, and overcoming maintenance barriers.

Action. Action in the WMT is influenced by increased awareness and use of social contextual influences and increased behavioral change processes. The action construct in the WMT informs which behavioral and health outcomes are relevant to the problem and population being studied. As the overarching goal of the WMI in this study is to enhance motivation for fall-preventive physical

activities, outcomes are linked to behavior (the quantity of physical activity behavior) and health (fall risk as indicated by functional leg strength and balance).

Theory-based Technology to Augment Wellness Motivation Intervention: Design and Pilot Test

A technological solution for measuring physical activity behavior and augmenting critical content in the WMI with real-time behavioral feedback using mobile computers was considered. Mobile computers have built-in accelerometers, which have emerged as a valuable objective measure of physical activity behavior in research (Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005) because they capture the intensity of dynamic movement. The accuracy of triaxial accelerometers in the iPod touch® and iOS platforms have been demonstrated (Manohar, McCrady, Fujiki, Pavlidis, & Levine, 2010). Mobile computers also have programmable applications (apps) that may communicate accelerometry data to users through persuasive tools. Persuasive apps have been developed that provide feedback about physical activity intensity, duration, and frequency as a way to foster motivation for health related behavioral change (Fogg, 2003).

Some persuasive apps are based on theory. For example, the UbiFit Garden, an app encouraging people to live an active lifestyle, was informed by the presentation of self in everyday life and cognitive dissonance theories (Consolvo, McDonald, & Landay, 2009). The design of Flowie, an app encouraging older adults to walk, was informed by the individual motivation theory, concepts in social psychology, activity strategies, and feedback from older adults using the

app (Albaina, Vastenburg, & van der Mast, 2008). Both the UbiFit Garden and Flowie apps highlight how theory can inform technology design, yet authors have not addressed issues specific to content validity in app design and implementation. While persuasive technology has been designed to help people change their everyday behavior, few interventions have been tested that integrate persuasive technology promoting fall-preventive physical activity in older adults (Albaina et al., 2008; McMahon & Fleury, 2012a).

Rationale. To address the need for theory-based technology designed to measure and promote physical activity behaviors among older adults at risk of falls, an iPod touch® app, Ready~Steady, was designed. The iPod touch® has a built-in accelerometer that is used in Ready~Steady to measure the quantity of physical activity behavior. The iPod touch® also has a programmable interactive interface that is used in Ready~Steady to deliver theoretically relevant motivational feedback and messages. The design process was iterative, whereby initial interdisciplinary planning was based on accepted theory-guided and user-specific design strategies, a motivational theory, and knowledge of mobile computers with built-in accelerometers and programmable apps. The initial steps in this cyclical process involved identifying the project's scope, app requirements from user perspectives (older adult study participants and researchers), and anticipated challenges. Key app functions were incrementally implemented, analyzed, evaluated, and redesigned. The purpose of this section is to (a) describe approaches used to design an iPod touch® app, Ready~Steady, to augment the WMI tested in this study; and (b) report a pilot study of the Ready~Steady

prototype evaluating the content validity of its theory-based motivational messages, usability and acceptability, and accuracy when used in the field.

Approaches. The design of Ready~Steady's interface was grounded in accepted theory-guided (Consolvo et al., 2009) and user specific (Chisnell, 2006; Pak & Maclaughlin, 2011) strategies. The WMT was used to specify, what, when, and how motivational content would be operationalized within the technology and linked to the WMI. Knowledge of accelerometer technology built into iOS platforms was used to develop a system for measuring physical activity frequency, intensity, and duration.

Interface display design: Accepted design strategies.

Theory-guided strategies. Consolvo and colleagues (2009) present principles for designing persuasive technology that encourage people to live physically active lifestyles. The design of Ready~Steady incorporated principles including interface characteristics that are (a) abstract and reflective, (b) unobtrusive, (c) public, (d) aesthetic, (e) positive, (f) controllable, (g) trending/ historical, and (h) comprehensive.

User-specific strategies. The Ready~Steady app was designed for use by adults over the age of 74 years old. Older adult populations are diverse, yet documented trends may influence iPod touch® and app use by older persons. For example, approximately 11% of older adults have smart phones (Smith, 2011), indicating that many older adults may not be familiar with smart phone technology. Further, prevalence rates of sensory and dexterity changes are higher among older adult populations compared with younger populations (Federal

Interagency Forum on Aging-Related Statistics, 2010; Pak & Maclaughlin, 2011), which requires design sensitive to these changes. To address user-specific factors that may influence technology use among older adults, design strategies included (a) minimalist displays, (b) error prevention, (c) clear visual displays, and (d) user support through written educational materials and telephone support (Chisnell, 2006; Pak & Maclaughlin, 2011).

Ready~Steady links to wellness motivation theory. The WMT was used to specify, what, when, and how motivational content would be operationalized within the Ready~Steady app. As previously indicated, the WMT conceptualizes motivation as a complex, dynamic process of individual growth based on personal values and resources, which directs the emergence of new and positive health patterns (Fleury, 1991, 1996). The Ready~Steady interface display provides feedback consistent with the WMT in real-time and trended over time. Table 3 outlines motivational tools and content developed within the app and their links to the WMT constructs designed to promote motivation for physical activity in older adults. In summary, Ready~Steady is designed to enable older adults to easily and comprehensively evaluate their pattern of physical activity over time. Positive messages and illustrations serve as a platform for self-assessment, setting realistic goals, receiving rewards, self-regulating activities, and problem solving.

Table 3

WMT: Links Between WMT Constructs and Ready~Steady Motivational Tools

Theoretical Dimension	Theoretical Construct	Problem(s) Contributing Fall Risk Due to Decreased Motivation for Balance and Strengthening Physical Activity	Ready~Steady Motivational Tools
Social Contextual Resources	Environ-mental Resources	• Access • Transportation • Physical Environs	Interface displays serve as a platform for discussion of environmental resources
	Social Resources	• Messages to take it easy • Limited social support from friends, family and healthcare providers	Interface serves as a platform for discussing the following in a socially supportive network • Rewards • Personal & community resources • Problem solving
	Biological Factors	• Changes in strength, balance, and mobility • Pain • Chronic illness	Interface provides • Individual feedback (real-time and trended) about physical activity quantity & progress over time • Encouragement to individualize goal setting and evaluation based on preferences and abilities
Behavioral Change Processes	Self-knowledge	• Gaps between desired & actual self • Lack of confidence • Fear of vulnerability • Belief that age prohibits benefits of physical activity and lends itself to inevitable falls	• Motivational messages that are positive and emphasize the importance of personal goals • Participants individualize and control their short-term physical activity goals.
	Motiva-tional Appraisal	• Limited plans to meet valued goals • Barriers identified without exploring why those are or how they might be overcome	• Positive motivational messages emphasize the importance of commitment to personal goals • Goal focused interface (goal statement, gauge /minute counter / blooming garden) informing progress toward goals • Feedback illustrating physical activity quantity over time thereby enabling reflection on barriers and strategies to overcome them
	Self-Regulation	• Limited system for monitoring and evaluating behavior and goal accomplishment • Limited connection between physical activity behavior and valued goals such as personal satisfaction	• Positive motivational messages encouraging engagement in and maintenance strategies to meet personal physical activity goals, even in the face of obstacles • Images that encourage self-monitoring and reflection about physical activity patterns as a basis for developing resources central to goal achievement
Action	Health Behavior	• Decreased physical activity	• Feedback about physical activity that is trended over time, allowing individuals to share achievements and progress with family, friends, providers as desired

Physical activity measurement. The Ready~Steady app uses the tri-axial accelerometer built-in to the iPod touch®, an iOS mobile platform, to measure the quantity of physical activity (frequency, intensity, and duration). While it is possible to program a range of sampling rates up to 100Hz in this sensor accelerometer, 10Hz adequately sensed physical activities commonly practiced in this target population, while optimizing battery life (Vankipuram, McMahon, & Fleury, 2012). Epochs are sampled at regular intervals across a minute to ensure that each minute's activity is represented in the data. In this study, activity was sampled in 5-second epochs every 15 seconds and accumulated (Vankipuram et al., 2012).

To remove noise in the data, it was first smoothed using averages computed over a sliding window. Physical activity intensity in Ready~Steady was measured using jerk, the combined derivative of acceleration. The key assumption behind utilizing jerk is that most gross human movement involves some jerk. This is the basic assumption that is used for cut-point classifications of physical activity in commonly used accelerometers such as the Actigraph (Freedson, Melanson, & Sirard, 1998). Jerk is a similar construct to an Actigraph count and therefore has a strong previous empirical basis for work. The Actigraph algorithms for counts are proprietary, thus other methods for creating proxy counts are warranted, such as what was used here and in previous experience exploring with smartphones (Hekler, Buman, Haskell, & Rosenberger, 2010). Estimating jerk compensates for constant offsets, such as gravity, without the need for additional calibration (Vankipuram et al., 2012). Jerk measures are

independent of device orientation, as three axes are added together (Vankipuram et al., 2012). Together, the advantages of utilizing jerk to estimate the intensity of physical activity simplifies user operation.

Energy expenditure estimates (e.g., thresholds for light, moderate, and vigorous physical activity intensity) based on the analysis of accelerometer measures have been demonstrated through calibration research (Matthews, 2005; Welk, 2005), yet this field is still developing. Findings in previous research may not directly apply to the target population for this study, older adults at risk of falls (Murphy, 2009; Welk, 2005). Many strategies appear to underestimate the energy cost of moderately intense lifestyle physical activities such as sweeping or vacuuming (Matthews, 2005) and overestimate the energy cost of locomotor activities, such as walking and running (Welk, 2005). To address limited differentiation, Crouter and colleagues (2006) demonstrated that coefficients of variation are larger for lifestyle activities than for locomotion activities and thus developed two regression equations accordingly. Despite important progress made in estimating energy expenditure from accelerometer data, more evidence is needed to understand how findings apply to free-living situations among older adults known to be at risk of falls or frailty.

Considering the goals of using this app and the potential for targeted users to have comorbidities and a high risk of falls, the range of energy outputs were first examined in a lab setting among four adults without known fall or health risks. Jerk was averaged over 90-second time frames on a treadmill at 0.5 miles per hour (mph) increments of speeds ranging from 0 to 5 mph. The average jerk

sensed for each increment was found to be significantly greater using one-way ANOVA ($p<0.001$) (Vankipuram et al., 2012). Preliminary thresholds were identified for no activity, sedentary, light, moderate, and vigorous activity intensities based on a simple rule based classifier correlating energy outputs (jerk) with established metabolic equivalent of task (MET) values (Ainsworth et al., 2011; Copeland & Esliger, 2009; Stewart et al., 2001) and treadmill speed as (a) no activity (jerk 4-15; estimated MET <1, 0-0.5 mph); (b) light intensity activity (jerk = 16-100; estimated METS 1 – 3; 0.5-3mph); (c) moderate-intensity activity (jerk = 101 -160; estimated METS 3.1-6; 3.1-3.9 mph); and (d) vigorous activity (jerk > 160; estimated METS >6; 4mph). It was also observed that when the iPod touch® rested on a countertop, jerk ranged from 0.1 to .39. While this small lab experiment demonstrated that the accelerometer used in Ready~Steady accurately senses a broad range of physical activity intensities with incremental treadmill speeds, thresholds identified were considered preliminary and not necessarily representative of the target population (Vankipuram et al., 2012). To enable further examination of physical activity intensity measured by the Ready~Steady app in this target population, data accumulated and stored continues to include average energy output (jerk) for each sampled epoch. The app was also programmed so that threshold values for no activity, light, moderate, and vigorous activity are configurable.

Ready~Steady prototype. The initial Ready~Steady prototype senses, analyzes, accumulates, and stores user physical activity data in terms of duration, intensity, and frequency. Feedback based on data is provided to users within the

interface display. Researchers are also able to access and analyze accelerometer databases for systematic group analysis. Figure 1 provides a simplified diagram of Ready~Steady's functional elements. Customizable elements include (a) a programmable interface display that may be blinded for data collection or with motivational illustrations and messages, (b) epoch lengths (1 to 60 seconds), (c) frequency of epoch sampling within a minute's time, (d) activity intensity thresholds, and (e) individual goals for physical activity duration.

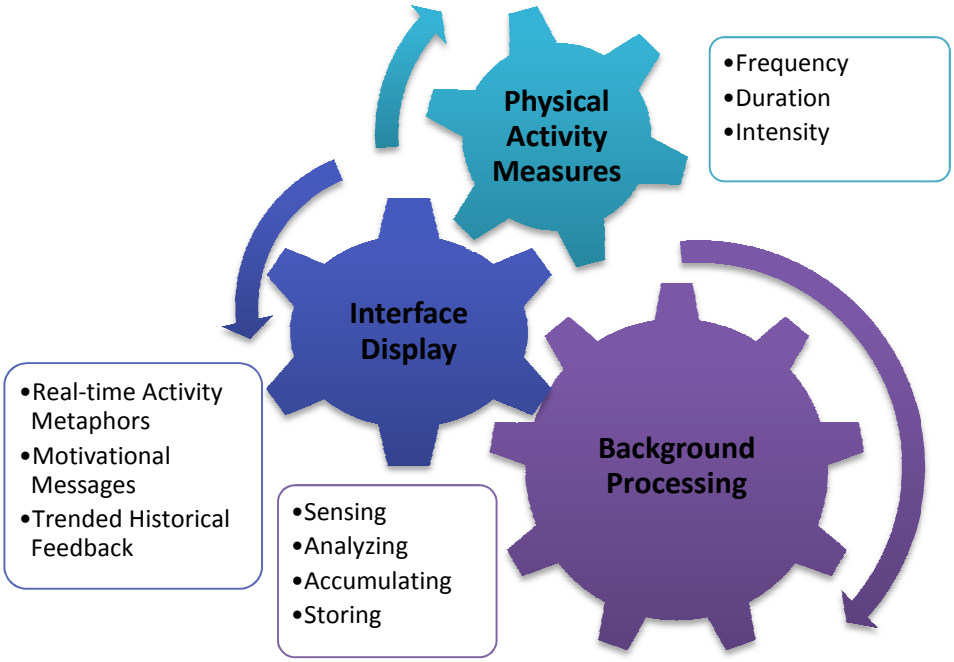

Figure 1. Ready~Steady's functional elements.

Ready~Steady evaluation. Approval from the Arizona State University (ASU) Institutional Review Board (IRB) was obtained to evaluate the initial

Ready~Steady prototype. Volunteers above the age of 60 were recruited to be interviewed and to use the prototype. Those who volunteered were considered to be an older adult expert panel for two reasons. First, the intervention research using Ready~Steady targets older adults. Second, the inductively developed WMT is based on experiences and perceptions of adults with an average age of 74 (Fleury, 1996). Engaging persons from similar populations is recommended when validating the relevance of new quantitative items (e.g., motivational content in the interface display) to previously inductively developed theoretical constructs (WMT constructs) (Fleury, 1993; Imle & Atwood, 1988; Stewart, Lynn, & Mishel, 2005). The aims of this evaluation were to assess the Ready~Steady prototype for (a) content validity of theoretically relevant motivational messages, (b) usability and acceptability, and (c) accuracy in the field.

The older adult expert panel evaluated the clarity of motivational content, internal consistency of content within each motivational frame, and content validity (Imle & Atwood, 1988). A detailed description of the evaluation, its purpose, and procedures was provided to each expert. Emphasis was placed on thinking beyond individual experiences to considering the relevance of individual items to the content domain (Stewart et al., 2005). Scoring sheets were used with boxes to mark judgments for each motivational message using 5-point scales ranging from 1 (strongly disagree) to 5 (strongly agree).

Several strategies were used to evaluate usability, acceptability, and accuracy in the field (Rubin, Chisnell, & Spool, 2008; Sauro, 2011). Structured

interviews were conducted that focused on learnability, effectiveness, and satisfaction using 5-point scales ranging from 1 (strongly disagree) to 5 (strongly agree). Four low fidelity paper images of interface display options were also evaluated. Two images were non-literal and aesthetically appealing. Two images represented different mechanical gauges. Experts were asked what each image illustrated, what information each provided, which of the images was easiest to understand, and which was most appealing. Four members of the expert panel also volunteered to use the iPod touch® over 4-7 days. They were asked to keep an activity journal so that journal entries and accelerometer data could be compared. Older adult experts also kept notes about their perceptions and experiences using and wearing the iPod touch®.

Analysis. Data were analyzed using descriptive statistics: frequencies for categorical variables and measures of central tendency for continuous and interval data. Comments were transcribed and examined for similarities and differences. Stored accelerometer data were examined for continuous sensing (at least eight hours per day). Comparisons of accelerometer energy output, estimated energy expenditure, and estimated MET of self-reported physical activities were examined using Spearman's rank correlation coefficient. Team members discussed evaluation results, and after reaching consensus about implications, improvements to Ready~Steady were planned and implemented.

Findings. Nine adults between ages 60 and 81 years of age volunteered for the pilot study. Four volunteers were female; five were male. Four reported using computers on a regular basis and three owned smartphones.

The older adult expert panel found that motivational content Ready~Steady was clearly worded. Most content within each motivational frame was internally consistent. Of the 12 motivational statements evaluated for relevance to corresponding WMT constructs and understandability, 10 elicited overall positive responses. Responses to questions about relevance to theoretical constructs ranged from 2 to 5 with means ranging from 3.3 to 4.78. Responses to understandability ranged from 3 to 5 with means ranging from 4.2 to 4.8. Experts responded to two of the 12 motivational items with scores ranging from 1 to 5 and averaging 3.1, indicating these motivational statements were not consistent with theoretical constructs. All older adult expert panel members suggested at least one additional motivational statement.

Usability items were positively rated with responses ranging from 3 to 5 and mean responses ranging from 4.4 to 4.6, indicating this expert panel evaluated the Ready~Steady app as one that can be learned and effectively used by older adults, and can be satisfying by older adults. Comments about initial learning and user directions included suggestions such as providing 1:1 demonstration charging the iPod touch®; and activating, using, and troubleshooting the Ready~Steady app. Additionally, one older adult expert also suggested that written instructions incorporate illustrations covering these key topics.

Responses to low fidelity images revealed that the majority of older adult expert panel members felt the image of a blooming garden was easiest to understand and the most appealing. Male and female experts also commented that having a gauge of some type and a minute counter helped them to evaluate

their daily activity and plan their actions accordingly. One older adult expert suggested removing the written goal statement altogether.

Four panel members wore an iPod touch® for 8-12 hours daily over the course of 4-7 days (which is in line with common estimates of a "valid" days based on accelerometry data) (Troiano et al., 2008). The majority of self-reported physical activities included sedentary activities (e.g., reading quietly) or low intensity activities (e.g., leisurely walking, cooking, light housekeeping, and gardening) with two episodes of moderately intense activity (e.g., walking briskly and heavy gardening) and two episodes of vigorously intense activity (e.g., jogging and bicycling at 17 miles per hour); all activities were sensed by the Ready~Steady. Spearman rank correlations calculated between energy output (median jerk) over times activity was reported, estimated MET values for types of activities reported, and activity energy expenditure estimates analyzed by Ready~Steady (using preliminary thresholds previously described). Correlation values range from $p = 0.668$; $P < .05$ to $p = 0.9167$; $P < .01$, indicating that Ready~Steady analyzes energy output data as programmed, but inconsistencies remain between the estimated MET values of certain activities, corresponding energy output values, and estimated energy expenditure in this group of older adults. Self-reported sedentary activities were analyzed as no activity and the majority of self-reported activities of light, moderate, and vigorous intensities were analyzed accordingly. Important inconsistencies included light intensity activities, strength and balance activities, and bicycling. Standing, considered to be a low-light intensity activity (Marshall & Ramirez, 2011), elicited a median

energy output of seven and was therefore analyzed as no activity. Leg strengthening and balance activities (e.g., calf raises, one leg stands, heel-toe walking) elicited a median energy output of 10.6 and were analyzed as no activity or light intensity activity. Jogging elicited a median energy output of 210 and was correctly analyzed as vigorous activity, while bicycling at an average of 17 miles per hour elicited a median energy output of 49 and was analyzed as light activity.

Expert panel members commented that counters displaying accumulated activity minutes beyond their individual goals helped them monitor their physical activity patterns. They also suggested that the range of minutes (0-60) on the Ready~Steady graph displaying historical activity was not broad enough and requested the y-axis of the graph be expanded to at least 150 minutes so that high values for total daily activity were visibly credited. One older adult expert observed that activity minutes accumulated when the iPod touch® was on the car seat, but not when worn on a belt while in the car, and suggested we include these details in explicit directions to future users. Most users preferred the elastic small personal item belt (Overton Enterprises, 2009) to wearing the iPod touch® in a pocket or on a belt clip.

Ready~Steady prototype improvements. Findings from the older adult expert panel evaluation were integrated into the Ready~Steady app. Table 4 outlines these improvements by strategies used in the original design. Figure 2 illustrates various images of interface displays within the updated Ready~Steady app prototype.

Table 4

Ready~Steady Prototype Improvements

Theory-Guided Strategies (Consolvo et al., 2009)	
Abstract and Reflective	• Interface displays include animated blooming garden that acts as a metaphor representing physical activity behavior and goal attainment. • Minutes of actual and targeted daily physical activity are displayed below the picture. • The abstract illustration blooms with activity according to individual goals, fostering self-knowledge (Fleury, 1996, 2007).
Unobtrusive	• Interface display is easily accessed, but only when needed or preferred by the user; it will not interrupt user activities and routines. • Motivational messages, consistent with WMT constructs, are accessed by tapping the interface screen (Fleury, 1996). • Older adults will not stand out as different for using an iPod touch®.
Public	• The abstract nature of the garden display ensures the user is socially comfortable in the event others become aware of it. • The iPod touch® is a frequently used mobile computer used in social situations, especially among younger populations (Smith, 2011). • Individual app output may be shared at user's discretion as a platform for discussion of goals, progress, personal and environmental resources, and problem solving in socially supportive networks (Fleury, 1991, 1996).
Aesthetic	• The garden display uses a feature that is traditionally aesthetic. • The iPod touch® is physically comfortable to wear when using small personal item belt (Overton Enterprises, 2009).
Positive	• Rewarding words and illustrations are used to encourage behavior. • Negative feedback is not used. • Based on WMT, abstracted data are illustrated in a positive image, encouraging users to reflect on personal behaviors in relationship to progress toward personal growth, and positive messages are provided to encourage progress (Fleury, 1991, 1996). • One motivational message found to be theoretically irrelevant was removed, another revised, and a new message added, based on older adult expert panel feedback.
Controllable	• Configurable elements include the appearance of output interface (e.g., blinded for data collection, feedback for intervention groups); threshold levels for estimating sedentary, light, moderate, and vigorous energy expenditure; epoch duration and frequency; and user activity goals. • Physical activity goals are individualized based on personal capacity, preferences, and values (Fleury, 1991, 1996).

Table 4, continued.

Theory-Guided Strategies (Consolvo et al., 2009)	
Trending & Historical	• A weekly graphic display is available of user daily total activity minutes over the course of time users wear the monitor. • Trended displays enhance user self-evaluation of activity patterns in light of social contextual factors and goals, thereby fostering self-regulation (Fleury, 1996, 2007). • Values on the y-axis of the weekly graphs were increased from 60 to 150 minutes according to evaluation results. • Mean energy output values were re-categorized as non-wear time (0 – 0.7); sedentary activity (0.71 – 6), light intensity activity (6.1 – 80), moderate-intensity activity (80 – 160), and vigorous intensity activity (>160).
Comprehen-sive	• Physical activity data are sensed, analyzed, accumulated, and stored as intensity, duration, and frequency values. Data include energy output of each epoch sampled. • In the WMT action is evidenced by a broad spectrum of physical activity behaviors. Individuals may intentionally integrate physical activities into activities of daily living; others may walk or engage in physical activities at scheduled times (Perez & Fleury, 2009). When in intervention mode, these data inform users of total activity time through interface illustrations /graphs.
User Specific Strategies (Chisnell, 2006; Pak & Maclaughlin, 2011)	

Minimalist Displays	• Interface displays minimize clutter and complexity of text and illustrations.
	• Three display screens accessible through corresponding icons constantly visible on all app displays.
	  • Home is a simple garden illustration occupying most of the interface.
	  • Information states, “watch the flowers BLOOM as you get more active” with three progressively larger pictures illustrating a growing garden.
	  • Graph is a historical display of a traditional graph; activity minutes (0-150) on the y-axis and day of the week on x-axis.
	▪ Arrows below the graph enable users to scroll through weekly results.

Error Prevention	• Simple explicit and implicit instructions are embedded into the Ready~Steady interface display. • The initial screen provides instructions for opening the program (“tap yellow icon”). • The information icon, described above, illustrates how to run the program. • Other iPod touch® functions and Ready~Steady app are placed in folders and taken off the main page; Internet connections are turned off.
Clear Visual Displays	• Large sized sans serif fonts are used. • Each display uses high contrast illustrations and messages. • The iPod touch® is programmed to automatically adjust brightness of the interface according to background lighting.
Help Documen-tation and Telephone Support	• A protocol for providing 1:1 instruction and demonstration of charging the iPod touch® and activating, using, and troubleshooting Ready~Steady was developed and tested that includes written instructions and illustrations. • The protocol also includes a follow-up phone call within 24-48 hours. • Instructor contact information is provided as a resource for troubleshooting.

Figure 2. Ready~Steady app: Exemplars of interface display (adapted from McMahon, Vankipurmam, & Fleury, 2012).

Theoretical Basis for the Wellness Motivation Intervention

The WMT serves as the theoretical basis for the Ready~Steady app and the WMI. For an intervention theory to meaningfully guide a study design and evaluation, it needs to address these essential elements: (a) the problem that the intervention focuses on; (b) intervention critical content (e.g., active ingredients); (c) intervention mechanisms; (d) expected outcomes; (e) extraneous factors; and (f) implementation issues (Sidani & Braden, 1998). Attention to these essential elements ensures the intervention theory is capable of explaining why, how, and under what conditions the intervention effects occur (Sidani & Braden, 1998).

Figure 3 summarizes the essential elements of the theoretical basis of the WMI and the following sections describe each element in detail.

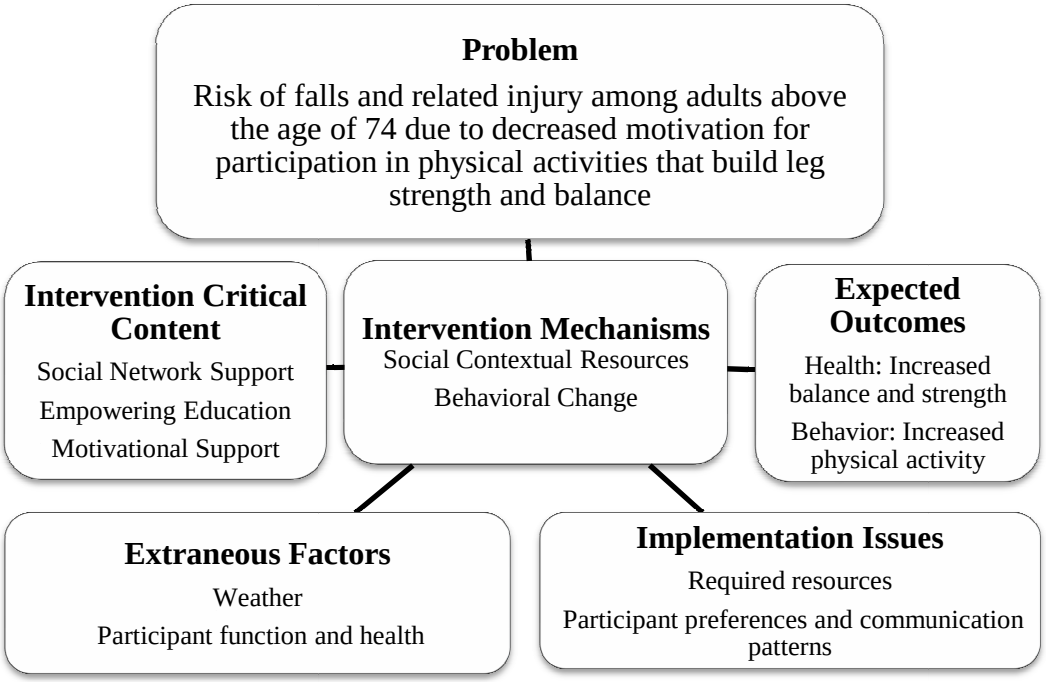

Figure 3. Elements of theory underlying the WMI.

Problem. The WMT explains the problem of decreased motivation for participation in physical activities that build leg strength and balance, specifying under what circumstances the problem exists and what will be relevant and irrelevant to address in the intervention (Conn, Rantz et al., 2002; Lipsey, 1993; Sidani & Braden, 1998; Whittemore, 2009). The problem addressed in this study was developed from reviewed literature, the WMT, and clinical experience. The problem addressed was increased fall risk and related injury among adults over the age of 74 due to decreased motivation for participation in physical activities

that build leg strength and balance. Motivational factors such as social support, self-systems, readiness, and self-regulation have been identified in research examining correlates, benefits, and barriers of physical activity initiation and maintenance among older adults. Decreased motivation to participate in physical activities among older adults manifests as limited awareness of social contextual resources and behavioral change processes. The possible consequences of decreased motivation to participate in fall-preventive physical activity include decreased muscle strength, decreased balance, increased fall risk, falls, injuries (e.g., head trauma, bone fracture), loss of independence, and death.

Critical content. Critical content of an intervention delineates the practical and procedural activities of the intervention theory (Lipsey, 1993; Sidani & Braden, 1998). The operationalization of the WMI is dependent on critical content (intervention active ingredients) to explain intervention activities and the mode of intervention delivery (Sidani & Braden, 1998). In previous research, the WMI critical content, social network support, empowering education, and motivational support have been developed and tested to (a) facilitate the awareness and use of social and environmental resources, (b) facilitate processes that enhance self-knowledge, and (c) individualize strategies that help foster the engagement in, and maintenance of, health promoting activities that reflect personal goals (Fleury, Belyea, & Harrell, 2000; Perez & Fleury, 2009).

Social network support. Social support for engaging in physical activity positively influences physical activity behaviors among rural, community dwelling women (Horne, Speed, Skelton, & Todd, 2009; Wilcox et al., 2009) and

other populations of older adults (Glanz, Rimer, & Viswanath, 2008; Newson & Schultz, 1996; Resnick, Orwig, Magaziner, & Wynne, 2002). Socially connecting with others promotes positive relationships which in turn re-awakens interests and increases the ability to identify prospects for future action (Shearer & Fleury, 2006). Research examining older adult perspectives of fall programs found that many older adults prefer group sessions with peers and are influenced by the advice of friends (Snodgrass & Rivett, 2005). Social network support in the WMI increases awareness of social contextual resources and behavioral change processes through group discussions and group participation in activities facilitated by an interventionist. Group formats used in the WMI provide a common context to effectively anticipate, interpret, and respond to others' needs, thereby providing social support. Group discussions in the WMI focus on solving problems such as overcoming perceived barriers to engaging in fall-preventive physical activity and accessing social support at home, in the neighborhood, and in the community. Groups also develop strategies and goals to create social networks that promote physical activities. Balance and strengthening physical activities are practiced together during which time individual barriers to participating in specific movements are addressed.

Empowering education. Empowering education refers to study participants identifying strengths within themselves and the community. Empowering education provides time and space for critically analyzing opportunities and developing strategies and resources to positively change individual behavior and community norms (Wallerstein & Bernstein, 1988).

Empowering education fosters identification and generation of personal, cultural, social, and contextual resources (Freire, 1989). In the WMI empowering education is enacted during facilitated group discussions about individual strengths and community resources. Resources are identified and evaluated. Specific strategies for decreasing fall risk through proven physical activities while ensuring safety are also addressed. Emphasis is on maintaining personally relevant goals and promoting positive self-identity rather than focusing on the threatening aspect of falls (McMahon et al., 2011; Yardley, 2007). For example, group discussions include topics about (a) the benefits of different types of physical activity (e.g., strength, balance, flexibility, and endurance); (b) the benefits of individualizing routines and progressing slowly, wearing safe footwear, and optimizing physical environments; and (c) individualized strategies for maintaining physical activity habits that integrate strength, balance, and endurance activities into everyday life.

Motivational support. Motivational support refers to study participants setting realistic goals and forming strategies for enacting those goals. Motivational support fosters the development of skills to adopt and maintain regular physical activity through (a) exploration and verbalization of personal values and goals related to physical activity; (b) strategy formation with anticipatory problem solving to manage current or expected barriers; and (c) exploration of monitoring, evaluating, and regulating approaches. Time is dedicated in group sessions to identifying and solving problems that limit motivation for fall-preventive physical activities. Plans include follow-up self-

evaluation of goals and accomplishments emphasizing rewards for achievement. Future goals are discussed and accomplishments are celebrated throughout the sessions.

Physical activities to prevent falls. Each WMI session in the study dedicated time to practice physical activities proven to reduce fall risk. The interventionist used the Otago protocol to guide specific physical activities and their progression over time (Gardner, Buchner, Roberson, & Campbell, 2001). Several fall-preventive physical activity guidelines have common similarities such as those found in the (a) 2009 National Institute on Aging (NIA, 2009) exercise and physical activity guidelines for older adults; (b) Australian Group Exercise Program (Lord et al., 2003); and (c) Veterans Affairs Group Exercise Program (Rubenstein et al., 2000). The Otago exercise programme was published in 2001 by an exercise physiologist in New Zealand providing specific guidelines for objective and systematic individualization of physical activities to reduce falls among community dwelling older adults who are at risk of falling. The Otago manual provides explicit instructor guidelines educational materials for older adults, including illustrated instructions for leg strengthening exercises, balance exercises, and a walking plan. The program has undergone extensive testing that demonstrates its feasibility (Robertson et al., 2001; Robertson, Campbell, Gardner, & Devlin, 2002). A meta-analysis combining data from four trials testing this program in home settings demonstrated 35% reduction in the number of falls and fall-related injuries (Robertson et al., 2002). The Otago program is

one of 10 recommended by the CDC in their compendium of evidence based interventions for fall prevention (Stevens, 2010).

Specific activities in the Otago protocol include gentle flexibility movements (e.g., back extension and ankle, head, neck, trunk movement), five leg strengthening activities (knee extension, knee flexion, hip abduction, ankle plantar flexion, ankle dorsiflexion), 12 balance activities (knee bends, backwards walking, walking and turning, sideways walking, tandem stance, tandem walk, one-leg stand, heel walking, toe walking, heel-toe walking backwards, sit to stand, stair walking), and a walking plan (Gardner et al., 2001). Initially the physical activity component of the WMI lasts for 10 minutes and progresses over the 8 week program. The Otago protocol provides guidance for individualizing the progression of activity duration and intensity each week. Safety strategies built into the exercise protocol include (a) gauging quantity and intensity of leg strengthening exercise by evaluating baseline strength (using ankle cuff weights); (b) holding on to a support structure when initially starting balance exercises, and only progressing individually; (c) following four levels of exercise progress specified in exercise program protocol; and (d) advising participants to stop exercising contact one's care provider if dizziness, chest pain, or shortness of breath occurs while exercising or if muscle pain occurs that does not cease (Gardner et al., 2001).

Theoretical mechanisms. Constructs within intervention theory must be well defined, to provide an explanation of the problem of interest, and to operationalize an intervention designed to address the problem (Lipsey, 1993;

Rothman, 2004). Theoretical mechanisms are those intervening variable(s) that account for behavioral change (Mitchie & Abraham, 2004). While many physical activity interventions in the field of falls prevention included critical content that provided information about resources, education, and social interaction, few measured or associated them with theoretical mechanisms of change such as perceived resources, self-knowledge, or perceived social support. Specifying critical content linked to theoretical mechanisms of change will help researchers and clinicians better understand the processes through which interventions achieve outcomes of interest. Intervention theories such as the WMT, whose constructs are specified and measurable, provide a basis for testing relevant theoretical mechanisms of behavioral change.

The intended effects of the WMI in this study are changes in health outcomes as indicated by fall risk and behavioral outcomes as indicated by physical activity behaviors. Achievement of these outcomes is contingent on increased awareness and use of social contextual resources and increased engagement in behavioral change processes. For these positive changes to occur, older adults experience social support and community resources, and increased self-knowledge, motivation appraisal, and self-regulation skills. Gains in theoretical mechanisms of change are contingent on participation in WMI sessions and fidelity of the intervention research (e.g., optimal interventionist training, intervention delivery, and intervention receipt by participants) (Bellg et al., 2004).

Outcomes. The WMT, through its explanation of the problem and guidance of the WMI, identifies expected outcomes related to behavior and health. The WMT as applied to adults over 74 years old, at risk of falls due to decreased motivation for physical activity, guides the identification of expected outcomes in this application of the WMI as (a) health outcomes focused on reducing fall risk, measured using functional strength and balances tests; and (b) behavioral outcomes focused on physical activities proven to decrease fall risk measured using subjective and objective strategies.

Potential extraneous factors. Environmental, social, and contextual extraneous factors may have direct or moderating effects on outcomes (Lipsey, 1993; Sidani & Braden, 1998). Extraneous environmental factors that may directly influence outcomes in this WMI study include changes in weather, limited transportation, and diverse participant situations and experiences. While this region of Minnesota typically experiences many sub-zero cold snaps and accumulates more than 100 inches of snow each winter, 2011-2012, the time during which the study was conducted accumulated just 21 inches of snow and did not have sub-zero temperatures. A plan for postponing meetings was established with each group (cancel criteria, alternative meeting time/place, communication strategies). Winter weather required that one of the control group meetings be rescheduled and prohibited two participants in an intervention group from attending one session.

Participants have varying experiences related to theoretical constructs. Despite recruiting people with similar ages it was anticipated that each participant

would have motivation influenced by varied access to resources, and identified barriers and facilitators to change. For example, some participants did not have access to community resources for physical activity due to distance or difficulty finding transportation. Thus dial-a-ride transportation was offered and coordinated through the study; eight participants used this. Additionally, the WMI is designed to address unique perspectives and situations of each participant.

Epidemiology studies of adults over 74 years of age report a wide variation of co-existing chronic conditions that may or may not affect motivation, perceptions, and abilities. The target population for this study has higher rates of changes in physical function, chronic illness, and/or injury than younger populations (Federal Interagency Forum, 2010). It was anticipated that such occurrences could influence access to transportation or health, thereby prohibiting continued participation in the intervention. To address anticipated variations such as changes in physical function, the WMI interventionist individualized the progression of strength and balance exercises. The number of repetitions and sets were adjusted in accordance with baseline and progressing strength as well as individual preferences and goals guided by the Otago protocol.

Intervention implementation issues. Implementation issues refer to aspects of intervention delivery that are essential for effective delivery, such as factors related to participant preferences, communication strategies, and required resources (e.g., setting, interventionist, necessary equipment) (Lipsey, 1993; Sidani & Braden, 1998).

Participant and community preferences. To better understand the target population, community partnerships were established beginning two years prior to initiating the study. Connections with organizations were made by attending key meetings. Information about the proposed study was presented and feedback was welcomed. Additionally, several older adult leaders in the community (e.g., leaders of senior clubs, bone builders classes) advised the principal investigator (PI) about strategies for data collection and study setting. In return, the PI provided educational presentations and participated in community events (e.g., wellness fairs).

Through community partnerships, awareness of the upcoming study grew and trusted agencies endorsed the study and participated in recruitment efforts. They suggested locations for posting the flyers such as local retail shops, restaurants, community centers, clinics, and the electric company. They also suggested attending small meetings and social gatherings in target communities. As a result flyers were posted in suggested locations and after connecting with community members leading local activities, the PI attended several local gatherings to share information on the flyer, answer questions, and personally invite individuals to participate. Some potential participants expressed a desire to bring a guest to intervention meeting sessions. For example, two potential participants were primary caregivers of their spouses who were living with dementia. They felt that even though their spouse might not formally enroll in the study, they could engage in the sessions and benefit by attending with them. Participants were therefore invited to bring a family member or friend to each

session. Approximately one guest attended each WMI and attention control group session.

In addition to supporting recruitment for the study, community members also provided advice and insight about where and when to conduct intervention and attention control group sessions and how to best collect data. Three study sites were suggested for the study, two of which were used. The third was not pursued in order to avoid conflict of interest; the PI has family in that area and did not want pre-existing relationships to bias recruitment and retention processes. It was suggested that group meetings be held at times that did not interfere with morning routines or meals and that were during daylight hours, any time between 1000-1130 or 1300-1530 would be best. All group meetings were held at those times. It was also suggested to avoid conducting the study during summer months as the region and many of its citizens are consumed with summer travel, events, and family activities. The study was conducted during fall and winter months. Another suggestion was to collect data during 1:1 interviews in locations preferred by participants (e.g., community centers or homes) rather than in groups or through the mail. Finally, community members preferred that attention control participants meet in groups to discuss the health and safety rather than simply receiving a newsletter about the topic. Thus, group sessions for attention control groups were planned and coordinated to occur in parallel fashion with WMI groups.

Communication strategies. It was anticipated that participants would have varying communication patterns and preferences. For example, biological

changes such as hearing and/or vision changes are common, but may not be obvious. Approximately 35.6% of older individuals in Itasca County have at least one disability. Forty two percent of older men and 30% of older women in Itasca County have hearing impairment, while 15% of older men and 18% of older women have vision impairment (Duay & Bryan, 2008; Federal Interagency Forum, 2010; U.S. Census Bureau, 2011). These changes may influence the way participants interpret and respond to the intervention. To address these potential changes, the study included specific environmental and interpersonal strategies to optimize individual and group communication. Seating arrangements during group meetings were in small circles. Those with known hearing impairments chose to sit close to the interventionist. Strategies used during data collection sessions and group sessions by the PI and research nurse to optimize communication included (a) ensuring they were facing participants and that their lips were in full view; (b) speaking distinctly, slowly, and directly to participants; (c) not exaggerating lip movement; (d) avoiding gum chewing, covering mouth, or turning away; (e) repeating messages using different words if the participant did not understand the original message; (f) not raising voice volume beyond moderately loud, instead lowering tone; (g) asking for feedback to assess what participants heard; (h) using body language congruent with messages; and (i) ensuring only one person talks at a time (Miller, 2008). Strategies used to optimize visual communication with participants included (a) sharing documents written with black ink against white non-gloss paper for good contrast; (b) ensuring documents requiring vision (including questionnaires, participant

manuals, and the interface of the interactive accelerometer) are written in at least 14 font, using high contrast colors, in sans serif, and in 3rd to 4th grade language; (c) using visual aids during meetings including flip charts and dark/thick markers; (d) ensuring that eyeglasses or reading aids are available to participants; and (e) asking for feedback to assess what the participant read and understood (Miller, 2008).

Thirty-three percent of persons living in Itasca County have a high school level education and the cognitive culture of this age group was characterized by preferring experiential learning, sharing stories, group discussions of relevant topics, and problem solving. Interviews for data collection were scheduled allowing time for (a) the PI to provide information and answer questions, (b) each participant to share stories important to them and to ask questions about the data collection process and the study, and (c) the research nurse to interview/collect data. Each intervention session combined short presentations with facilitated group conversation about relevant topics. The content in participant manuals was designed to be congruent with the principles of adult and older adult learning and organized into chapters of information corresponding with each of the eight group meetings. Each chapter had information about the weekly topic that was interspersed with reflection and discussion topics and room for notes. Participants were encouraged to view the upcoming chapter prior to each session and to refer to the manual for questions they had between sessions.

***Required resources*.** Resources required for the delivery of this intervention study include adequate settings, a well prepared interventionist, and

relevant technology aids. Groups (4-7) met for 90 minutes weekly over 8consecutive weeks. Each meeting included time for socializing and a light snack. Community centers were chosen for group sessions as they were familiar and welcoming to study participants. They had safe, conveniently located, parking lots and well lit meeting areas, equipped with sturdy chairs and tables.

It was anticipated that the interventionist would be vulnerable to role confusion. Personal characteristics and roles other than interventionist such as being a community member and a nurse practitioner could have influenced intervention implementation and evaluation. Role confusion has the potential to interrupt intervention delivery affecting dose and integrity, thereby affecting intervention implementation and outcomes. For example, the interventionist was also employed as a gerontological nurse practitioner (GNP) by a health system that serves Itasca County. Though her practice was not in Itasca County, her association with the health system may have negatively or positively influenced potential participants' interest in the study. Some participants had positive and trusting relationships with this health system while others had negative perceptions and distrust of the health system. Some feared their participation in the study might threaten their benefits, independence, or privacy. Additionally, factors such as the interventionist's beliefs and interest in the intervention, interpersonal communication skills and styles, and knowledge and skill related to delivering the WMI could have influenced how the intervention was received and understood. There was a single interventionist, making it difficult to rule out direct effects of participant response to the interventionist.

To address these potential problems, the PI was oriented and trained to deliver the manualized WMI. Study procedures included time for explaining the study and all items on informed consent. The integrity of each intervention and attention control session was evaluated by the interventionist using Index of Procedural Consistency. An external reviewer who was educated about the WMI evaluated the integrity of 25% of the intervention and attention control group sessions via audiotape recordings of randomly chosen sessions. Field notes were kept, and time was taken to reflect on experiences and the field notes. Regularly scheduled research staff meetings provided additional opportunities to discuss study recruitment and intervention delivery, and to correct drift from the standardized procedures.

Technology aid. As described, a new iPod touch® app prototype, Ready~Steady, was designed to provide technological aid to the WMI by (a) measuring the quantity of physical activity behavior through its built-in accelerometer, and (b) augmenting the delivery of WMI critical content through its interface capable of conveying theoretically relevant motivational feedback and messages. This technology was pilot tested for content validity of its theory-based motivational messages, usability and acceptability, and accuracy when used in the field. Several strategies were integrated into the app design and instruction procedures to minimize complications such as (a) instructions on the iPod touch® opening screen about how to open Ready~Steady ("tap yellow icon"), (b) instructions embedded into the Ready~Steady interface display including an information icon illustrating how to run the program, (c) placing iPod touch®

functions and applications in folders and taken off the main page, and (d) using large sized sans serif fonts with high contrast illustrations and messages and programming the iPod touch® to automatically adjust brightness of the interface according to background lighting. A protocol for providing 1:1 instruction and demonstration of charging the iPod touch® and activating, using, and troubleshooting Ready~Steady was developed and evaluated based on pilot study findings. The protocol includes written instructions with illustrations and a plan for providing follow-up phone calls within 24-48 hours. Resources were also provided for help with troubleshooting.

Intervention model. The intervention model illustrated in Figure 4 summarizes and outlines the hypothesized relationships between critical content, theoretical mechanisms of change, and outcomes of the WMI in this study. Increased awareness and use of relevant social contextual resources and positive behavioral change processes influence the behavioral outcome of physical activity and the health outcome of increased balance and leg strength to reduce fall risk.

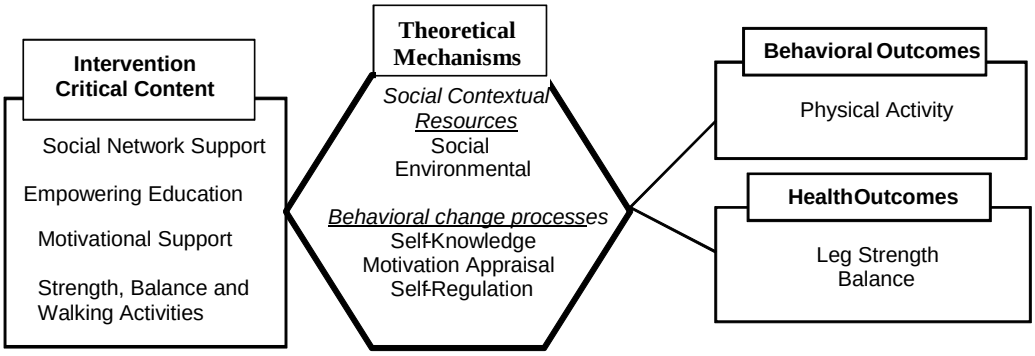

Figure 4. Intervention model.

Summary

Despite the identification of motivation as an important determinant of physical activity, few fall-prevention interventions in older adults have focused on motivational factors, including social contextual resources and behavioral change processes, few fall-prevention interventions have been based on theoretical models for behavioral change. Researchers in the field of fall prevention have documented the efficacy of physical activities that emphasize building balance and leg strength to reduce the risk and rate of falls among older adults across risk levels (Gillespie et al., 2009). The WMT explains the problem of risk for falls and related injury among adults above the age of 74 due to decreased motivation for participation in physical activities that build leg strength and balance, specifying under what circumstances the problem exists and what will be relevant and irrelevant to address in the intervention (Lipsey, 1993). Combining proven physical activities with theory addressing motivation for behavioral change will (a) make explicit the components and activities comprising the intervention, (b) clarify expected outcomes based on the nature of intervention effects, (c) clarify theoretical mechanisms of change necessary for the expected outcomes of the intervention, and (d) identify conditions that may affect intervention effectiveness (Sidani & Braden, 1998). Theoretical explanations guiding how and why older persons engage in fall-preventive physical activities will help to build the science of falls prevention, thereby fostering application of effective interventions in clinical practice.

Chapter 3

RESEARCH DESIGN AND METHODS

There is empirical support for both the relevance of the WMT among older adults at risk of heart disease (Fleury,1996; Perez, 2010) and the biomechanical effects of multicomponent strength and balance activities among older adults (Gillespie et al., 2009). It is not known how these combined strategies work to promote physical activity among rural, community dwelling older adults at risk for falls. To determine if a combined approach is appropriate for full scale testing in this population, there is a need for feasibility research to identify to what extent the WMI (a) is acceptable to program participants, (b) is used by program participants, (c) is successfully delivered to rural, community dwelling older adults, and (d) shows promise in limited efficacy testing (Bowen et al., 2009; Mitchie & Abraham, 2004). This chapter summarizes the design of a WMI feasibility study, including methods used to evaluate its acceptability, demand, implementation, and limited efficacy in increasing motivation for physical activities proven to reduce fall risk among community dwelling older adults in rural settings. The WMI critical content is introduced. Research design and methods are reviewed in detail.

Wellness Motivation Intervention

The WMI designed to increase motivation for physical activity to reduce fall risk among community dwelling older adults was approved by the ASU IRB and the IRB at Essentia Health, which covers 14 hospitals and 65 community clinics across Northern Wisconsin, Northern Minnesota, and North Dakota. The

theory-based intervention in this study was based on critical content delivered in previous research testing the WMI (Fleury, 1996; Perez, 2009), the Otago program of physical activities to reduce fall risk (Gardner et al., 2001), the results of Ready~Steady pilot testing, ongoing review of the literature, and clinical knowledge. In practice both the WMI and integrated technology, Ready~Steady, are individualized according to participant goals and preferences, rather than being tailored to any specific population characteristic.

In this feasibility study the WMI was delivered as eight weekly group sessions lasting 90 minutes each. A warm/accepting atmosphere was maintained in group sessions through respectful interaction. Program length and group sizes (4-7) used were consistent with previous fall-prevention intervention research (Gillespie et al., 2009; King et al., 1998; McMahon & Fleury, 2012).

Wellness motivation intervention. The WMI was individualized through attention to the unique goals and physical activity functional capacity of each participant. The critical content of the intervention included (a) social network support through a community-based, group intervention; (b) empowering education focused on identifying and creating social contextual resources; and (c) motivational support to enhance resource identification and used to promote behavioral change processes. The WMI is group-based, and designed to build individual capacity to enable initiation and maintenance of fall-preventive physical activity over time. Participants set and evaluated personal physical activity goals each week. They self-monitored their progress using an exercise diary and the Ready~Steady app provided by the PI. Strength and balance

activities were practiced as a group, and illustrated descriptions of recommended physical activities to reduce fall risk were included in participant manuals for reference when using at home (Gardner et al., 2001). The critical content delivered by the WMI is outlined in Table 5.

Table 5

Critical Content in Eight-Week WMI Study

Wellness Motivation Intervention Meetings	
Social Network Support, Empowering Education, Motivational Support	Physical Activity (Otago) 4 levels of difficulty applied individually and progressively*
Session 1 Getting Started	
• Social Network Support: Introductions and expectations. Introduce/review the Ready~Steady app • Motivational Support: Introduce the purpose and outline of the program. Review and goal for the next week. Demonstrate and practice app use and feedback. Integrate immediate goals into each individual's Ready~Steady app • Empowering Education; Identify individual resources	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises; Front knee strength • Balance: One leg stand • Walking: Walk in place 3 minutes
Session 2 Benefits	
• Social Network Support • Motivational Support: Brain storm about what is best, meaningful, enjoyable. Review progress seen on Ready~Steady app, and set immediate PA goals for the week. Frame fall risk in personally relevant ways. Explore benefits of physical activity on quality of life, well-being, strength, function. Identify activities/ exercise that are personally meaningful. • Empowering Education: Identify and discuss individual resources and community resources	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength • Balance: One leg stand • Walking: Walk in place 5 minutes. Explore walking activities; advice about walking using usual pace with aid, 2 times per week for 30 minutes; 3 10 minute segments ok.

Table 5, continued.

Wellness Motivation Intervention Meetings	
Session 3 Where Are You Going?	
• Social Network Support: Share past experiences and concerns about PA. Discuss champions for change • Motivational Support: Review and set immediate goals for the week; share thoughts about feedback from Ready~Steady; Brainstorm about physical activity that promotes safety. Information about safety strategies; progressing into routines; gauging progress on signals from your body • Empowering Education: Identify individual and community resources that support new ways of being active	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength • Balance: One leg stand • Walking: Walk in place 10 minutes
Session 4 You Are On Your Way	
• Social Network Support: Discuss offering positive feedback to self and others • Motivational Support: Discuss personal time for physical activity. Review accomplishments. Review and set goals for the week. Discuss weekly graphs on Ready~Steady. Explore how to turn normally inactive events into PA events. Questions and concerns about Ready~Steady and how it senses activity • Empowering Education: Discuss individual and community resources that are supportive	• Flexibility: Ankle, head, neck, trunk, back • Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength • Balance: One leg stand; toe raises • Walking: Walk 10 minutes
Session 5 Plan to Succeed	
• Social Network Support: Discuss being champions for change • Motivational support: Review and set immediate PA goals for the week. Reset minute goals on Ready~Steady according to participant evaluation and requests. Discuss ways to overcome barriers • Empowering Education: Discuss personally relevant strengths and resources in self and community	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength; sit to stand • Balance: One leg stand; toe raises • Walking: Walk 15 minutes
Session 6 Accentuating the Positive	
• Social Network Support: Discuss role as champions for change in encouraging, acknowledging others in their efforts to be active. • Motivational Support: Set PA goals for the week. Review activity diary and Ready~Steady graphs for patterns (e.g., times, decisional antecedents, development of plans/ habits). Identify celebration strategies • Empowering Education: Review resources used. Identify negative thoughts about physical activity and discuss ways to replace those with positive thoughts	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength; sit to stand; side hip strength • Balance: One leg stand; toe raises • Walking: Walk 15 minutes

Table 5, continued.

Wellness Motivation Intervention Meetings	
Session 7 Keeping Yourself On Track	
• Social Network Support: Discuss ways to help others to stay on track • Motivational Support: Review and set PA goals for the week. Discuss ways to overcome setbacks • Empowering Education: Discuss ways to shape surrounding and / or create cues for staying active	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength; sit to stand; side hip strength • Balance: one leg stand; toe raises; knee bends • Walking: Walk 20 minutes
Session 8 Putting It All Together	
• Social Network Support: Discuss ways participants might continue to involve their community in being active. • Motivational Support: Discuss progress and success in program. Discuss changes in view of self as an active person. • Empowering Education: Discuss resources identified and used in the last week Celebration	• Flexibility: Ankle, head, neck, trunk, back • Strength: Calf raises: Front knee strength; Back knee strength; sit to stand; side hip strength • Balance: one leg stand; toe raises • Walking: Walk 20 minutes

*Recommendations were given to practice physical activities reviewed 2 times during the week and to walk each day.

Attention control. Parallel contacts were carried out with attention control and WMI participants. Attention control group sessions emphasized health and safety. Group discussion centered on content of weekly newsletters addressing topics related to older adult health and safety adapted from the National Institute on Aging (2009) fact sheets for older adults. Attention control group content was not theoretically relevant, or linked to any construct in the WMT. The content of attention control group sessions is outlined in Table 6.

Table 6

Attention Control Group

	Safety and Wellness Topics (*Based on National Institutes of Health/National Institutes of Aging, Minnesota website for falls prevention)*
Session 1	*Getting Started* *Introductions* *Review* Program purpose *Review* Notebook *Discuss* Aging, your eyes and fall risk
Session 2	*Safety at Home* *Review* Factors that contribute to fall risk *Identify* Environmental factors that increase fall risk *Review* Safety checklist *Discuss* Safety strategies used in participants' homes
Session 3	*Pain and Medication Safety* *Discuss* Experiences with pain *Share* Ideas about easing pain; What works for you? *Review* Role of Pain medications *Discuss* Medication and fall risk
Session 4	*Sleep* *Discuss* Age related changes in sleep architecture *Discuss* How sleep affects function and safety. Individual strategies used by participants. *Identify* Strategies that improve sleep quality
Session 5	*Nutritional Supplements* *Define* Supplements *Discuss* The effects /purpose of common supplements. What works for you? *Identify* Over the counter medications *Discuss* The potential side effects of supplements and OTC on safety
Session 6	*Aging and Your Ears* *Identify* Changes that affect hearing *Discuss* The effects of hearing loss on daily life and function *Identify* Ways to optimize hearing
Session 7	*Staying Hydrated and Well-Nourished* *Identify* Discuss ways that nutrition and hydration affect safety *Discuss* Facilitators and barriers to staying hydrated. *Identify* Ways to overcome barriers to eating well and staying hydrated. Make healthy recipe of smoothies
Session 8	*Foot Health* *Discuss* How feet can affect safety *Identify* Three ways to ensure your feet stay healthy. *Review* Factors that contribute to fall risk.
	Celebration

Research Design

To address the problem of decreased motivation for participation in physical activities that influence the risk for falls and related injury among adults over the age of 74, this feasibility study used a randomized, controlled trial design. The acceptability, demand, implementation fidelity, and limited efficacy of the WMI were evaluated among rural, community dwelling older adults. Designed as a repeated measures study, there was one between-subjects factor (WMI versus attention control) and one within-subjects factor (time; T1, T2). Regardless of assigned treatment group, all participants underwent testing one week (T1) prior to the start of the study protocol and immediately after completion of the eight-week protocol (T2). This feasibility study provided an opportunity to estimate effect size, power, and sample size needed for a larger efficacy study (Bowen et al., 2009). The attention control group provided both a contemporaneous comparison control as well as a strategy for optimizing study retention by providing opportunities for study participants to engage in health-related activities (Lindquist, Wyman, Talley, Findorff, & Gross, 2007).

Research Methods

Sample. A total of 43 older adults were screened from October 24, 2011 through February 2, 2012; thirty met inclusion criteria and were enrolled into the study. Inclusion criteria included (a) speaking English, (b) living in a rural community, (c) being over 74, and (d) not currently participating in regular physical activity (Kearney, de Graal, Damkjaer, & Engstrom, 1999), an exercise program, or physical therapy. Exclusion criteria included (a) being legally blind

(self-report); (b) taking certain psychoactive medications (e.g., Haloperidol, Quetiapine) on a regular basis (self-report); (c) having a diagnosis of dementia (self-report) or score on the telephone Mini Mental State Exam (MMSE) of ≤ 21 / 26 (Newkirk et al., 2004); (d) having foot, knee or leg injury, surgery, or infection in the last six months; and (e) not having healthcare provider clearance, which was obtained for all participants using a standardized process.

English-speaking adults over the age of 74, without a diagnosis of dementia, not currently participating in regular physical activity, and residing in rural communities were targeted for this study. Injurious fall occurrence increases with age. Rates of falls among persons between the ages of 75 and 80 years and those 85 and older are 1.6 and 4 times greater respectively than rates among persons between the ages of 65 and 74 (WISQARS, 2011). While there are numerous risk factors for falls, age and gait and balance changes aggravated by limited physical activity top the list (Rubenstein, 2006). Receipt and enactment of the WMI requires cognitive capacity for goal setting and evaluation; thus older adults with diagnosed dementia were excluded from participation. Residing in rural areas is associated with higher leisure time inactivity rates among women and men, and in all older adult age groups and income groupings when compared with those who reside in urban settings (National Center for Health Statistics [NCHS], 2012). Approximately 49.8% of metropolitan dwelling persons are have sedentary lifestyles compared to 56.9% in non-metropolitan areas. This disparity may be related to physical characteristics within environments (e.g., fewer sidewalks in rural communities), interpersonal factors (e.g., less social support for

being active), and intrapersonal factors (e.g., less education, lower income) (Wilcox, Castro, King, Housemann, & Brownson, 2000). People in rural areas tend to (a) have less access to health care, (b) have lower incomes, and (c) rate their health and function lower than individuals who live in urban areas (Wilcox et al., 2009). Few of the previous fall-preventive physical activity intervention studies included rural populations. Thus, this study targeting rural dwelling older adults will contribute to the science of fall preventive interventions in older adults.

The number of participants enrolled in this feasibility study was based on available resources for the study. A dropout rate of 30% was anticipated based on published multicomponent physical activity interventions in similar populations (McMahon & Fleury, 2012a). The small sample size is appropriate for this study given the goal of estimating an effect size for a larger scale randomized controlled trial. As this was a feasibility study, power analysis had limited utility during the planning stages. Power curves generated for hypothetical large and medium effect sizes indicated respective sample sizes of 24 to 90 would be needed for the study to yield a statistically significant effect with 80% likelihood (assuming .65 correlations between time points).

Setting. The setting for this study was two rural communities, Deer River and Marcell, in Itasca County, Minnesota. Wellness motivation intervention and attention control group sessions took place in community center meeting rooms. Community centers had adequate space, lighting, bathroom facilities, and parking. Both were located in low-crime areas. Sturdy, comfortable seating was available

for each participant. Rooms used were dedicated to study meetings during times reserved. Delivering the intervention in dedicated spaces controlled for inconsistencies, noise interruptions, and random irrelevant activities that have the potential to interrupt intervention delivery. Communication plans were made with each group regarding a strategy for rescheduling sessions in the face of severe weather. Transportation was offered to participants via local dial-a-ride services.

Recruitment and retention. Recruitment was conducted by the PI in collaboration with staff at the Arrowhead Agency on Aging and through communication with community leaders, senior centers, and clinics serving older adults in Itasca County. Information letters were distributed to promote the awareness of the program among community members and healthcare providers who work in or near the recruitment area. The PI presented the study purpose and procedures to clinicians (e.g., primary care clinic providers) and older adults in the region (e.g., Elder Circle Council on Aging) during meetings designed to address health and aging issues. Recruitment flyers were developed in collaboration with the Arrowhead Agency on Aging and Elder Circle highlighting the study purpose and procedures. Volunteers were recruited using flyers in combination with in-person presentations. Volunteers indicated interest during regularly occurring community events where flyers were presented, including bingo games, cribbage games, luncheons, and dinners. Interested individuals were invited to share their contact information with the PI, who coordinated times

and locations for meetings to conduct eligibility screening, informed consent, and baseline measures.

Recruitment efforts targeted study participants whose gender, race, ethnicity, socioeconomic and health status are representative of the older adult population in Itasca County, located in the north central Minnesota geographic region. The targeted area, Itasca County, has a population of 43,992, 80% of whom live in rural locations. Among persons over 74 in this area, 59% are female (U.S. Census Bureau, 2011). The majority of people living in this region are White, with African Americans, Native Americans, Asians, and Hispanics or Latinos comprising 0.4%, 3.5%, 0.5%, and 0.8% of this population respectively (U.S. Census Bureau, 2011). A total of 3,917 persons aged 75 and older live in Itasca County. County areas with the highest proportion (20-35%) of adults over age 65 include areas near the towns of Grand Rapids, Deer River, Big Fork, Marcell, and Nashwauk/Keewatin (Douma et al., 2009). Participants were recruited from two of these rural communities, Deer River and Marcell, whose respective populations were approximately 903 and 436 (U.S. Census Bureau, 2011). The median income of persons (per capita) living in Itasca County is $17,717; 6.4% of persons over 65 live below the poverty line (U.S. Census Bureau, 2011). The highest level of educational attainment for 34% of persons in Itasca County older than 25 is a high school diploma; 11.9% have an associate's degree; 14.7% have a bachelor's degree; and 6.2% have a professional or graduate degree (U.S. Census Bureau, 2011).

Recruitment and retention processes integrated contextually important strategies including personal contact between participants and PI through invitation/reminder phone calls, emphasis on potential benefit of research findings to others, and provision of warm/accepting atmosphere through respectful interaction. To facilitate continued participation, the frequency, duration, and extent of expected participation was clearly communicated verbally and via personalized meeting calendars shared at the beginning of the study. Information about what to anticipate in terms of time and procedures was also shared prior to each data collection time point. The PI telephoned WMI and control participants to remind them of scheduled data collection times. Participants were compensated with a $10 gift at each measurement time point. Personalized thank you cards and certificates of achievement with group photographs were also provided to each study participant.

To promote study adherence, weekly attendance was encouraged throughout the intervention sessions. Attendance rosters were checked weekly; reminder telephone calls were made to participants who missed a session. The PI met weekly with mentors and the research team to discuss study progress including recruitment, retention, implementation procedures, protocol deviations, adverse events, new research evidence, data collection, and data management.

Data Collection Procedures

Testing procedures in the WMI and attention control groups were congruent. Data collection was standardized across T1-T2 and took place at the affiliated community centers or within participant homes, according to participant

preference. Testing procedures were conducted by two research nurses trained in the study purpose, the WMI, and data collection protocol. Research nurses were blinded to study condition. Both completed a Collaborative Institutional Training Initiative course addressing the protection of human research subjects. Specific training for testing procedures took place in three phases for a total of 12 hours. The PI trained the research nurses in measurement of variables, including both self-report questionnaires and physical assessment. Education and training was delivered through a web-based module and live interactive sessions. Learning domains addressed by training objectives were cognitive and psycho-motor in nature. The cognitive domain emphasized strong mental skills ensure that research nurses had a foundation from which to problem solve in the face of differences or challenges encountered during study measurement sessions. Within the cognitive domain the first three objectives addressed knowledge, analysis, and synthesis levels, respectively. The psycho-motor domain introduced in this module was designed to promote skills required for the research nurse role. Overall, training facilitated the acquisition of knowledge and skill as a basis for developing competencies to accurately conduct testing procedures. Specific learning objectives addressed during research nurse training included: (a) identify the purpose of the research; (b) describe procedures used in the measurement sessions; (c) practice evidence-based communication approaches in the face of common age related sensory changes; and (d) review testing procedures consistent with measures, data collection requirements, and common participant characteristics. The research nurses and the PI independently obtained study

measures on two test volunteers to support competence and establish inter-rater reliability and competence.

Screening

Potential participants were screened for study inclusion during face-to-face or telephone interviews using a screening form, which included information about the participant's age, use of psychotropic medications (Reuben, Roth, Damber, & Wegner, 2003), cognitive functioning via self-reported diagnosis of dementia and a telephone version of the MMSE (Newkirk et al., 2004). The Exercise And Screening for You (EASY) survey, and using the Stages of Change questionnaire (Kearney et al., 1999) were also used. Persons who were eligible were invited to a pre-intervention appointment that combined consent processes, enrollment, and baseline (T1) testing procedures. Those concerned about falls, but not interested in or eligible for the study, were referred to other community resources.

Cognitive function was evaluated by absence of self- reported dementia or a dementia-related illness, the ability to provide informed consent, and a score of at least 21 out of 26 on the telephone MMSE (Newkirk et al., 2004). Screening for safe participation in physical activity was done using the EASY survey (Ory & Resnick, 2008). All participants received a clearance from their physician prior to participation using a standardized system that was established prior to study initiation. Health care providers were informed about each potential participant's interest in the study and were asked to contact the PI if they had concerns. Communication and clearance was also confirmed and documented from the

clinic nurse. The questionnaire's six items use Yes or No responses to questions about signs of cardiovascular dysfunction during activities, history of ever being diagnosed with high blood pressure, presence of pain that prohibits activities, current dizziness, falling or feeling unsteady, and any additional participant concerns that warrant intervention tailoring or medical evaluation. Those who responded Yes to high blood pressure were reminded of recommended guidelines for treatment and follow-up; those who reported pain with activity or reported additional concerns were provided with pertinent educational resources and information (Ory & Resnick, 2008). Participants who were dependent on an assistive device for ambulation were asked to integrate their assistive device into activity sessions for safety reasons.

Informed Consent and Enrollment

Eligible and interested participants provided informed consent. The PI and research nurse met with each participant individually to review the risks, benefits, and options of study participation. Each eligible participant was also given a written copy of the consent form for review. Potential participants, their loved ones, and caregivers were encouraged to ask questions or meet with the PI privately to further clarify questions or express concerns. For those who provided informed consent (written and verbal), baseline measurements (T1) were also initiated. See Appendix B to view a current copy of the consent form.

Random Assignment

Participants were randomly assigned to the WMI or the attention control group immediately after informed consent, using a table of blocked random

numbers generated from SPSS. Two blocks including lists of random treatment assignments for 20 individuals, assigned to two conditions (10 in each group) were created. This approach was chosen as the study is delivered to groups of individuals. Random assignment enhances internal validity by maximizing the chance that participants in intervention and attention control groups have similar characteristics and that differences between groups are not systematic. Participants were informed of their group assignment, to the WMI or attention control group, with instructions regarding where and when to meet for group sessions.

Training for Intervention Delivery

Intervention sessions were led by the PI. To develop competencies for delivering the WMI, the PI acquired specialized knowledge and skill about older adult principles of learning and communication, facilitating groups, assessing for social contextual factors and behavioral processes, fall-preventive physical activity programs (Otago), and facilitating individually driven behavioral change processes.

Intervention Fidelity

Intervention fidelity refers to the intervention being delivered as designed (Sidani & Braden, 1998). Lack of intervention fidelity increases the risk of analysis error, or concluding that the intervention is not effective when it has not been implemented as designed (Sidani & Braden, 1998). Systematic attention to factors that potentially impede delivering the intervention as planned is recommended as a standard approach to the conduct and evaluation of health

behavior research (Bellg et al., 2004). Process methodologies used in this study addressed fidelity through intervention design, interventionist preparation, intervention quality monitoring and improvement (described in Measures and Variables section), evaluation of participant receipt of treatment, and enactment of skills learning during the intervention sessions.

The intervention design was central to maintaining fidelity and correcting drift from intended protocol. The dose, or the number, frequency, content, and length of each session, was standardized for this study. Content for both the WMI and attention control group sessions were manualized. Flipcharts were used to guide discussions. Each flipchart page, prepared prior to group sessions, highlighted a key concept covered in that session with blank space left for group discussions. This helped to standardize presentations and facilitate conversation, enabling the interventionist to focus on group responses and reflections.

As the interventionist is the medium through which the intervention is delivered (Sidani & Braden, 1998), interventionist preparation is also central to maintaining implementation fidelity. The PI was trained as a WMI interventionist to facilitate the delivery of critical content in the WMI. A manual was also developed for this study with group session-specific objectives, content outlines, and learning activities guided by scripting. Feedback from WMI experts, practice, and refresher training ensured that interventionist skills did not decay or drift over time (Bellg et al., 2004).

The WMI manual integrated strategies to ensure participants' enactment of learned intervention skills. Receipt and enactment of intervention content was

promoted through the use of weekly activity calendars, the development of individual goals, and the facilitation of group discussions regarding progress, accomplishments, and perceived barriers. Discussions included topics related to physical activities enacted at home between intervention sessions and use of the Ready~Steady app. Physical activities were practiced during each session. Participant comprehension and perceptions of intervention session content, group facilitation, and physical environmental characteristics were assessed on an ongoing basis. Throughout each session the interventionist conducted formative assessment through group discussions of scripted questions documented on the flip chart and summarized in the field notes. Field notes included information about each session: summarized observations of participants' responses to each of the session's objectives. Regularly scheduled team meetings provided additional opportunities to discuss and correct drift from the standardized procedures. In addition to manual guided fidelity processes, an Index of Procedural Consistency and external review of randomly chosen group session audiotapes both served as measures of fidelity.

Variables and Measurement

Variables categorized as demographic characteristics, acceptability, demand, fidelity, and efficacy were measured using standardized questionnaires and procedures upon participant consent and enrollment (T1), and immediately post-intervention (T2). Supplies and equipment needed for data collection (e.g., data collection packets, pencils, visual analog scales, tape measures, custom made step, and calibrated stop watches) were organized to be portable and available for

each data collection session. The study team coordinated individual data collection sessions lasting up to two hours, during which standardized questionnaires were read to participants and questions were clarified. Measurement strategies were standardized across WMI and attention control groups, and were conducted by a research nurse blinded to study condition. Data collection sessions were conducted in community center meeting rooms or in participant homes, according to participant preference.

Demographic characteristics. Demographic and fall risk variables were measured to describe the target population and ensure randomization processes minimized allocation bias. Demographic measures were obtained at T1: (a) age in calendar years, (b) gender, (c) race, (d) number of years of schooling completed, and (e) socioeconomic status measured as monthly income and number of individuals living in the household. Self-reported fall risk factors were also obtained at T1 including number of falls in the last year, presence of perceived imbalance or difficulty walking, and the use of a walking aid T1 (AGS et al., 2010).

Intervention acceptability. The acceptability questionnaire was administered one time in the post-intervention measures (T2) to the WMI group. Intervention acceptability is a reflection of participant views, expectations, and preferences. Interventions that are acceptable are more likely to be adhered to (Kazdin, 2003). An investigator-developed questionnaire was used to evaluate acceptability targeting two major aspects of the intervention and its domains: (a) intervention components (utility, effectiveness, credibility, and satisfaction); and

(b) mode of delivery (format and strength). Participants were asked to what extent they agreed with items representing these aspects of the intervention using a scale ranging from 1 (strongly disagree) to 5 (strongly agree). Participants were also invited to describe how the program may be improved. Examination and analyses of the resulting narrative data informed intervention acceptability evaluation.

Ready~Steady app usability and acceptability. Participants were asked to what extent the Ready~Steady app was learnable, satisfying, and effective, using seven items with scaled responses ranging from 1 (strongly disagree) to 5 (strongly agree) (De Vito Dabbs et al., 2009; Rubin et al., 2008; Sauro, 2011). Participants were also invited to describe in their own words how the Ready~Steady app might be improved, providing narrative data as an additional evaluation source.

Intervention demand. Details about study attendance and attrition (intervention demand) provided a basis for refining future studies (Bowen et al., 2009). In this study, an attendance log was used to track participation in group sessions. An attrition log was used to record date and rationale for participants leaving the study, allowing the research team to evaluate acceptable and unacceptable intervention attributes. Attrition rates were calculated as the percentage of persons volunteering for the study and providing consent, but missing three or more consecutive intervention sessions. Within two weeks after meeting the nonattendance requirement, dropouts were telephoned and asked if

they had stopped participating in the intervention with no intention of returning and about reasons for dropout.

Implementation fidelity. Quality monitoring was used to address both WMI and attention control group session fidelity, or the extent to which the intervention was delivered as planned. Implementation fidelity was evaluated through field notes and an Index of Procedural Consistency. Field notes were kept and reviewed for each intervention session outlining tasks addressed and accomplished, time spent on each task, support materials used, and intervention delivery methods used. 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 fidelity. The index was designed to capture fidelity to WMI and attention control session objectives using a scale ranging from 1 (not at all delivered) to 3 (delivered very well).

Intervention sessions were also randomly audiotaped for external review by a GNP, trained in the WMI, to evaluate presentations, group interactions, content delivery, and comprehension. The GNP listened to 25% of WMI and attention control group sessions and evaluated each using narrative comments and Indexes of Procedural Consistency for each session. The interventionist reviewed notes, the Indexes of Procedural Consistency, and feedback from the external reviewer, reflecting on WMI delivery and fidelity.

Social contextual resources. Social contextual resources were measured using the Social Support for Exercise Survey and the Perceived Environmental Support Scale at T1 and T2. The Social Support and Exercise Survey is a

questionnaire that measures participant perceptions of social support for exercise from family and friends (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Internal consistency has been supported in older adults (Cronbach's α ranging from .84 to 91) (Sallis et al., 1987). The Perceived Environmental Support Scale (Sallis et al., 1997) addresses community resources for physical activity including walking trails and senior centers, perception of neighborhood safety and physical characteristics (e.g., presence of hills and enjoyable scenery) (Sallis et al., 1997). Test-retest correlations ranged from r =.80 to r = .68 for items pertaining to community resources and perceived neighborhood environment respectively (Sallis et al., 1997).

Behavioral change processes. Behavioral change processes were measured at T1 and T2 and include self-knowledge, motivation appraisal, and self-regulation. Self-knowledge was measured using the Possible Selves Questionnaire and the Goal Attainment Scale. The Possible Selves Questionnaire is a set of three open-ended questions and two Likert items designed to elicit feared selves, goals, and related activities. Self-efficacy and outcome expectancy related to activities and health goals were measured using a scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Frazier, Hooker, Johnson, & Kaus, 2000). Responses to open-ended questions were summarized using content analysis. In earlier testing, inter-rater reliability across domains was 87-98% (Cross & Markus, 1991; Frazier et al., 2000). Measures of health-related possible selves are better predictors of health behaviors than health values and highlight the motivational role of self (Fleury, 2002; Fleury, Sedikides, & Donovan, 2002).

The Goal Attainment Scale is an individualized measure of personally meaningful goals and outcomes, evaluating the extent to which individual goals are achieved. The Goal Attainment Scale has been characterized as person-centered, reflecting intentions of treatment, and sensitive to change among persons in rehabilitation and geriatric medicine settings (Rockwood, Stolee, & Fox, 1993; Turner-Stokes, 2009). For the purposes of this study personal goals and expected outcomes related to health, activity, medication, and safety were established during an interview between each participant and the research nurse. Goals were specific, measureable, achievable, realistic, and timed, making it easy for participants to evaluate outcomes at T1 and at T2. Evaluation of goal attainment ranges from -2 (least favorable outcome) to +2(most favorable outcome). A composite score was calculated into a standardized T score prior to analyses (Kiresuk & Sherman, 1968; Rockwood et al., 1993; Turner-Stokes, 2008)

Motivation appraisal was measured using the Index of Readiness (Fleury, 1994). Items evaluate the creation of strategies that guide behavioral change, acknowledgment of behavioral change barriers, and commitment to change, all of which are integral to initiation of behavioral change processes (Fleury, 1994). The nine items in the Index of Readiness (three subscales) have response scales ranging from 1 (strongly disagree) to 5 (strongly agree). Internal consistency reliability estimates (Cronbach's α) for total scores in older adults have been reported as .89 and for subscales are .72-.80 (re-evaluation of lifestyle), .81-.82 (barrier identification), and .67-.89 (goal commitment) (Enriquez, 2004, 2009; Fleury, 1994). Initial criterion validity tested in adults and older adults supported

low to moderate associations between Index of Readiness subscales, re-evaluation of lifestyle, identification of barriers, and goal commitment, and a theoretically related criterion measure of current health behaviors (r =.19 - r =.35) (Fleury, 1994).

Self-regulation was measured using the Index of Self-Regulation, a questionnaire that examines factors associated with the continuation of regular physical activity (Fleury, 1998). The Index of Self-Regulation contains nine items on a scale ranging from 1 to 5 (strongly disagree to strongly agree) with three subscales measuring reconditioning, stimulus control, and behavioral monitoring; a total scale score indicating the use of self-regulatory mechanisms in maintaining behavioral change over time was used in this study. Internal consistency reliability estimates (Cronbach's alpha) have been reported to be .70 to .90; with total scale retest reliability of .82 (Fleury, 1998; Moore et al., 2006). Initial estimates of criterion related and construct validity were calculated as correlations between Index of Self-Regulation subscales and theoretically related criterion measures (r =.20-r =.47) (Fleury, 1998).

Behavioral outcome variable of physical activity behavior. Physical activity was evaluated at T1 and T2 using subjective and objective measures. The Community Health Activities Model Program for Seniors (CHAMPS) measures the type, frequency, and intensity of physical activity behaviors that individuals have performed in the previous four weeks (Stewart et al., 1997). This questionnaire is sensitive to changes in physical activity, and includes items representing physical activities of varying intensities commonly practiced in

community dwelling older adult populations. Each item inquires about an activity's presence or absence in the last week, and how frequent and for what duration the physical activity occurred (Stewart et al., 1997, 2001). Subscales include estimates of weekly kilocalorie use, frequency and duration of all activity and moderately intense activity (and greater) (Stewart et al., 1997, 2001). Testing for discrimination between three sub-populations was significant for all four subscales ($P<.001$) (Stewart et al., 2001). All subscales were sensitive to changes after an intervention when compared to a control group ($p<.05$) (Stewart et al., 2001). Hekler and colleagues (2012a) added items to the CHAMPS survey reflecting additional sedentary and light intensity activities. Subscales including light intensity activities (low and high categories) and sedentary activities have also been evaluated (Hekler et al., 2012a). Spearman rank order correlations between CHAMPS subscales and accelerometer measures of sedentary, low-light, high-light, moderate-vigorous, and all activity have been reported as $p = 0.12$, $p = .06$, $p = .27$, $p = .27$ and $p = .38$ (Hekler et al., 2012a). In this study, the CHAMPS survey as modified by Hekler and colleagues (2012a) was used. One item inquiring about use of public transit (buses/trains) was not used because the study was conducted in a county with no public bus or train lines. The CHAMPS questionnaire is used frequently in older adult populations, supported by recently published follow-up of a large community-based falls prevention program (Laforest et al., 2009) and physical activity program (Wilcox et al., 2009).

In addition to self-reported physical activity behaviors, a triaxial accelerometer within the Ready~Steady app was used to monitor the frequency,

duration, and intensity of physical activity over seven days at T1 and T2. Accelerometers have emerged as a valuable objective measure of physical activity behavior in research (Murphy, 2009; Narayanan et al., 2009; Ward et al., 2005) as they capture the intensity, duration, and frequency of dynamic movement. The accuracy of triaxial accelerometers in the iPod touch® and iOS platforms have been demonstrated (Manohar et al., 2010). The accelerometer within the Ready~Steady app measured accelerations during unsupervised daily activity. The app was programmed to be in a blinded mode during data collection periods. Study participants did not receive feedback from the app at these times.

Physical activity frequency and intensity in this study was measured using jerk; the combined derivative of acceleration was estimated, compensating for constant offsets, such as gravity, without the need for additional calibration (Vankipuram et al., 2012). Jerk measures are independent of device orientation, as three axes are added together (Vankipuram et al., 2012). Jerk is a similar construct to an Actigraph count, and therefore has a strong empirical support. As the Actigraph algorithms for counts are proprietary, other methods for creating proxy counts are needed, such as what was used in this study. Together, the advantages of utilizing jerk to estimate the intensity of physical activity simplified user operation.

While it is possible to program a range of sampling rates up to 100Hz in this sensor accelerometer, 10Hz was found to adequately sense physical activities commonly practiced in this target population, while optimizing battery life (Vankipuram et al., 2012). Epochs were sampled at regular intervals across a

minute to ensure that each minute's activity was represented in the data. In this study, activity was sampled in five-second epochs every 15 seconds and accumulated. Mean energy output (jerk) for each sampled epoch was accumulated and stored. Mean energy output values were categorized as non-wear time (0 – 0.7); sedentary activity (0.71 – 6), light intensity activity (6.1 – 80), moderate-intensity activity (80 – 160), and vigorous intensity activity (>160), according to preliminary results from the Ready~Steady pilot study (McMahon, Vankipuram, Hekler, & Fleury, 2012; Vankipuram et al., 2012).

Participants were given the accelerometer at TI and T2 with 1:1 instructions about wearing and using the accelerometer. The Ready~Steady apps were programmed during these data collection periods to provide no feedback to participants. Participants were asked to wear the accelerometer continuously from the time they got dressed in the morning until their bedtime, at least 10 hours per day for seven days. They were asked to remove the accelerometer while bathing, showering, or swimming (Cain & Geremia, 2011; Trioiano et al., 2008). In addition to 1:1 instructions, participants were provided with illustrated written instructions and troubleshooting resources. To support adherence to measurement protocol, participants used logs to record dates and times they wore the monitor and meaningful activities (Cain & Geremia, 2011). Participants were called 24-48 hours after receiving the accelerometer to answer any questions about wearing or operating the accelerometer. Accelerometers were retrieved by the PI after 7 days of measurement, when data were downloaded as xml files.

Health outcome variables. Functional balance and strength were measured at T1 and T2 using the Up and Go, the Berg Balance Scale, and the Short Physical Performance Battery. The Up and Go is a modified Timed Up and Go test designed to be usable within the homes of community dwelling older adults. Like the Timed Up and Go, the Up and Go evaluates dynamic balance and mobility by measuring the time taken to stand up, walk eight feet, turn, and return to a sitting position. Test-retest reliability of the Up and Go has been excellent (.95) (Rikli & Jones, 1999). Sensitivity and specificity for identifying older adults prone to falls are approximately 78% and 86%, respectively (Rose, Jones, & Lucchese, 2002). The Berg Balance Scale evaluates 14 tasks that test static balance. Each task is valued up to 4 points, with a maximum possible score of 56 (Berg, Wood-Dauphinee, Williams, & Maki, 1992). Inter-rater reliability has been good (ICC=.88-.98) (Bennie et al., 2003; Berg et al., 1992), correlation with other static balance measures (e.g., Balance Screening Tool, r=0.82-0.92) is stronger than it is with dynamic balance measures (e.g., Timed Up and Go, r=0.47-0.69) (Bennie et al., 2003). The Short Physical Performance Battery includes timed repeated chair stand, semi-tandem, side-by-side, tandem balance testing, and a timed walk. Scores for each item are totaled for a summary score ranging from 0 to12 (12 indicates no impairments) (Guralnik, Ferrucci, Simonsick, Salive & Wallace, 1995). The gradient of resulting scores validly reflects lower extremity strength variation seen in older adult populations. The large Women's Health and Aging study (Onder et al., 2005) support the significant predictive effects of the Short Physical Performance Battery tests had

on progressive disability; the timed walk predicted catastrophic disability (RR=.57; CI=.41-.80).

Data Management and Analysis

Measurement tools and the data collection packet for T1 are provided in Appendix C. Coded data collection forms completed at each measurement time (T1-T2) were reviewed for missing information, and all were stored in a locked file cabinet. Participants were assigned a study number; personal identifiers were kept separate from questionnaires and other data collection forms. Data was double entered as independent SPSS 19 files. After data entry was completed, files were evaluated using SAS PROC compare procedures; discrepancies were identified and compared to raw data forms.

Data were reconstructed for repeated measures ANOVA using linear mixed models into two cases per participant. Descriptive and inferential analyses were conducted using SPSS 19 and SAS 9.2.

Specific Aim 1. Analysis was descriptive. Summary measures of means and standard deviation (SD) for continuous variables were examined and described. Attendance rates and attrition as well as reasons for attrition were analyzed for WMI and attention control groups through investigator logs.

Specific Aim 2. Analysis included:

1. Descriptive statistics to summarize demographic characteristics and major variables of interest.

2. Data were examined to evaluate normal distribution. If not normally distributed, data were examined for outliers. Missing data were examined for

systematic patterns using SPSS 19 missing value analysis procedures. Zero to 13% of the data was missing, with most variables having no missing values. Values for missing data were not imputed as repeated measures analyses were conducted through mixed model procedures, which uses all available data and thus are a form of intent to treat analysis.

3. Two participants who dropped out of the study were compared to those who completed the study; all pretest variables were compared to those who completed the study. Analyses did not suggest potential sample bias.

4. Participants in the WMI and attention control groups were compared on demographic variables measured at pretest (T1), using independent sample t-test or Fisher's exact test, as appropriate.

5. Correlation tables were constructed for social contextual variables, behavioral change processes, and outcome variables at T1 using and Pearson's product moment. Correlation tables were also constructed for total daily activity and light intensity activity as measured by the accelerometer and the CHAMPS survey using Spearman's rank correlation coefficient.

6. The CHAMPS survey duration items were coded per protocol (Stewart et al., 2001) and categorized as sedentary activity; and low-light, high-light, moderate/ vigorous intensities (Hekler et al., 2012). The majority of activities reported by participants in this study were light intensity and sedentary. Analyses focused on total activity (moderate/ vigorous intensity plus light intensity activity) and light intensity activities.

7. A program was created in SPSS to manage accelerometer data. To screen for non-wear time, histograms were constructed for each day of activity providing a visual display of the hourly frequency of non-wear time, and sedentary, light, and moderate physical activity times (Cain & Geremia, 2011; Pruitt et al., 2008). Data from days on which the participant did not wear the monitor for at least eight hours were considered invalid and were not included in the analysis (Cain & Geremia, 2011; Trioiano et al., 2008). A minimum of three days of wear time was required to estimate daily and weekly averages of physical activity (Hart, Swartz, Cashin & Strath, 2011). Similar to findings from the CHAMPS survey, the majority of physical activity sensed by accelerometers was light intensity. Therefore, mean minutes of light intensity activity per day were used in analyses.

8. A marginal model approach to repeated measures ANOVA using mixed model procedures in SPSS and SAS was conducted to evaluate changes in social contextual resources, behavioral change processes, and outcomes as a function of time, treatment group, and time*treatment interactions. Analyses were conducted using all available data, including data from participants who dropped from the study before data collection T2 (e.g., intent to treat). Levene's test of variance equality was significant in follow-up measures (T2) of the Berg Balance Scale, the Up and Go, and the Short Physical Performance Battery, requiring analyses with an unequal-variance ANOVA model through SAS 9.2, PROC MIXED. Results were similar in both analyses. When repeated measures ANOVA revealed a significant difference, follow-up repeated measure analyses with

planned contrasts to evaluate the specific aims were planned. Adjustment for multiple comparisons was made using Bonferroni corrections.

9. Cohen's *d* effect sizes for social contextual resources, behavioral change processes, and outcome variables were calculated by subtracting the mean of attention control group from the mean of the WMI group and divided by the pooled standard deviation.

Summary

Unintentional falls among community dwelling older adults are a common, serious, and potentially preventable public health problem. While there is empirical support for the positive effects of physical activity to prevent falls, the majority of older adults do not engage in everyday physical activity behaviors. This study builds on existing falls prevention research and previous research testing the WMI by examining the feasibility of the WMI among rural community dwelling older adults who are at risk of falls, using a randomized controlled trial design. Research design and methods allow evaluation of WMI acceptability, demand, implementation fidelity, and efficacy in increasing social contextual resources, behavioral change process variables, the behavioral outcome of engaging in physical activity, and the health outcome of fall risk reduction among rural, community dwelling older adults.

Chapter 4

RESULTS

The purpose of this study was to test WMI feasibility (acceptability, demand, implementation, limited efficacy) in rural, community dwelling older adults. The WMI focused on enhancing motivation for physical activities proven to reduce fall risk. The study was designed to increase physical activity behavior, balance, and strength, through increased awareness and use of social contextual resources and motivation for behavioral change. Acceptability of the intervention was evaluated among participants in the WMI groups. Demand and implementation of the intervention were evaluated among participants in both WMI and attention control groups. The intended effects on theoretical mechanisms and outcomes within and between treatment and attention control groups over time were also analyzed. Study results are presented according to specific aims and prefaced by a brief description of the sample and psychometric properties of measures used.

Sample Description

Figure 5 outlines the recruitment flowchart (Moher et al., 2010). In summary, 43 individuals expressed interest in the study and were screened for eligibility. Thirty met inclusion criteria, provided consent to participate in the study, and were randomized to treatment or attention control groups. In total there were three WMI groups and three attention control groups. Twenty-eight participants completed the study. Two participants (one in treatment group and one in attention control group) did not complete the study due to (a) death from a

co-existing condition, and (b) increased caregiving responsibilities of a son who became ill during the study.

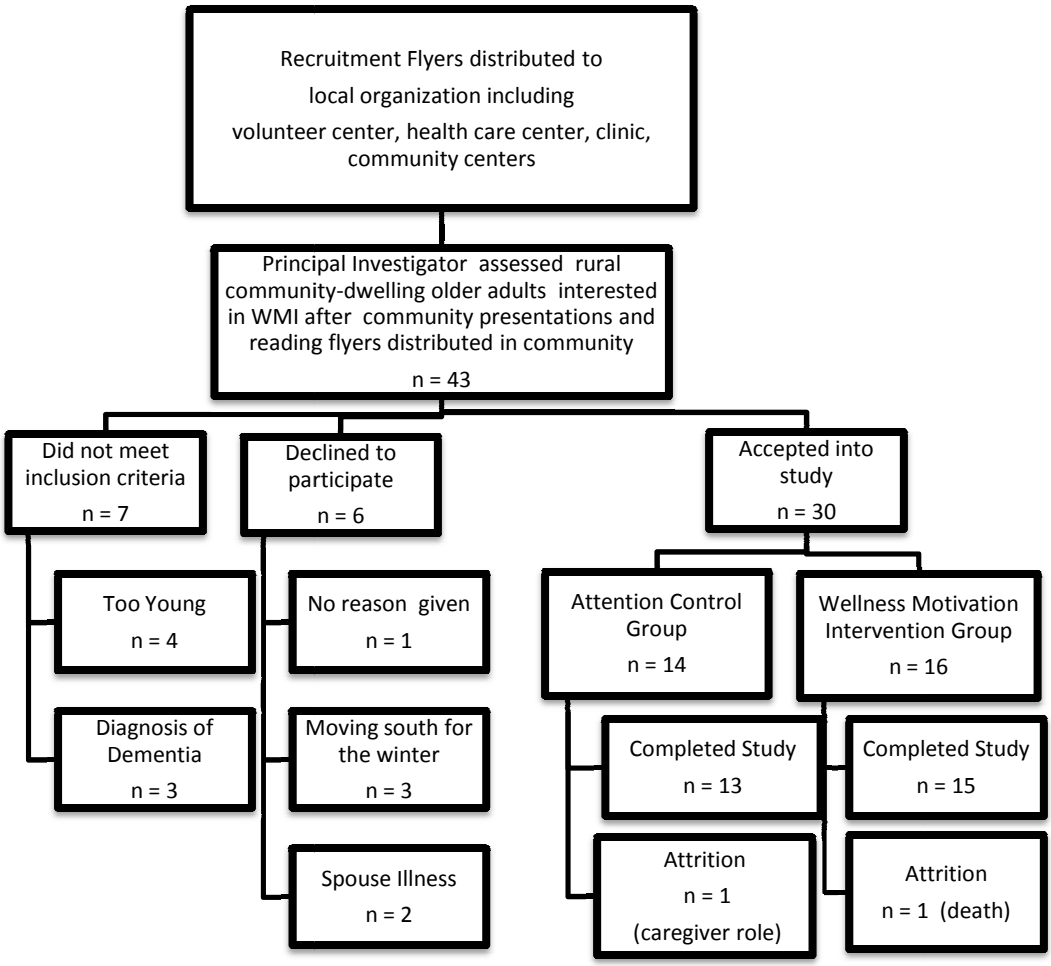

Figure 5. Recruitment flowchart.

Table 7

Demographic Characteristics of Study Participants

	Attention Control Group (n=14)	Intervention Group (n=16)	Total
Age			
Range	74- 90	76-93	74-93
Mean (standard deviation)	83.93 (4.8)	83.31 (4.7)	83.6 (4.7)
Race			
White	13 (92.9%)	16 (100%)	29 (96.7%)
Native American	1 (7.1%)		1 (3.3%)
Name of principle tribe	Anishinaabe Ojibwe		Anishinaabe Ojibwe
Sex			
Female	13 (92.9%)	15 (93.8%)	28 (93.3%)
Male	1 (7.7%)	1 (6.3%)	2 (6.7%)
Employment Status			
Part time	1 (7.1%)		1 (3 .3%)
Full time	1 (7.1%)		1 (3.3%)
Retired	8 (57.1%)	9 (56.3%)	17 (56.7%)
Volunteer	4 (28.6%)	7 (43.7%)	11 (36.6%)
Monthly Income			
$100 to $499	1 (7.1%)		1 (3.3%)
$500 to $999	1 (7.1%)	3 (18.8%)	4 (14.3%)
$1,000 to 1,499	6 (42.9%)	2 (12.5%)	8 (26.7%)
$1,500 to $1,999	3 (21.4%)	6 (37.5%)	9 (30.0 %)
$2,000 or more	3 (21.4%)	3 (18.8%)	6 (20%)
Not Sure		1 (6.3%)	1 (3.3%)
Refused		1 (6.3%)	1 (3.3%)
Years of Education			
Mean (standard deviation)	12.7 (2.2)	11.5 (1.6)	12 (1.9)
<12 years	2 (14.2%)	3 (18.8%)	5 (16.7%)
12 years	6 (42.9%)	11 (68.8%)	17 (56.7%)
Some Tech or College	4 (28.5%)	2 (12.6%)	6 (19.9%)
≥4 year College	2 (14.2%)		2 (6.6%)
Number of people living in home			
1	10 (71.4%)	13 (81.3%)	23 (76.7%)
2	2 (14.3%)	3 (18.8%)	5 (16.7%)
6	1 (7.1%)		1 (3.3%)
7	1 (7.1%)		1 (3.3%)
Fall Risk			
Number of falls in last year			
0	10 (71.4%)	8 (50.0%)	18 (60%)
1	1 (7.1%)	2 (12.5%)	3 (10%)
2	3 (21.4%)	2 (12.5%)	5 (16.7%)
>2	0	4 (25%)	4 (13.3%)
Use of walking aid	7 (50%)	9 (56.3%)	16 (53.3%)
Difficulty walking	5 (35.7%)	6 (37.5%)	11 (36.7%)
Problems with balance	6 (42.9%)	5 (31.3%)	11 (36.7%)

Demographic characteristics for study participants are presented in Table 7. Participants ranged in age from 74 to 93 years, with a mean of 83.6 years. The majority of participants were White (96.7%); one participant was Native American, of the Anishinaabe Ojibwe tribe (3.3%). These proportions are similar to Itasca County demographics and Minnesota demographics, which indicate the majority of the population in these regions is white with percentages of Native American populations ranging from 0.9% to 0.6% (U.S. Census Bureau, 2011). Ninety-three percent of participants were female. Similar to county, state, and national demographic statistics (U.S. Census Bureau, 2011), the majority of participants had at least a high school education (83%). Levels of educational attainment ranged from eight to 16 years. The mean highest educational attainment level was 12 years. Fifty-seven percent of the study participants considered themselves to be retired and 33.3% worked as volunteers. Participants reported monthly incomes ranging from $100-$499 (7.1%) to more than $2,000 (20%), with the majority (57%) between $1,000 and $1,999. Seventeen percent of individuals indicated their annualized monthly income was at or below poverty guidelines (annual income of 11,170 or less) (USDHHS, 2012), compared to county, state, and national levels for persons over 65 reported as 9.0%, 8.3% and 9.25% respectively (U.S. Census Bureau, 2011). Seventy- seven percent of participants lived alone; 7% lived with (6-7) extended family members. National survey statistics reveal that approximately 40% of persons over 65 live alone (Federal Interagency Forum on Aging-Related Statistics, 2010). Sixty percent of participants had not fallen in the last year; 53.3% used a walking aid; 36.7%

reported having difficulty walking; and 36.7% reported having problems with balance.

Intervention and attention control groups were examined for systematic differences on key baseline demographic and fall risk variables. No significant differences were detected in age, race, sex, education level, number of persons living in household, monthly income, number of falls in the last year, use of a walking aid, walking difficulty, or imbalance using independent t tests and Fisher's exact test.

Environmental resources were measured using the Perceived Environmental Support Scale, which inquired about neighborhood characteristics, community resources for participating in physical activities, and the extent to which participants walk or see others walk in the neighborhood. Results of items in this measure are described, but were not included in inferential analyses as the items in the scale are not interrelated. Most study participants described their neighborhood as residential (46%) or rural (36%). Some reported living in mixed residential/commercial (10.7%) or mainly commercial (7%) area. 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, unattended dogs, attractive natural sights, frequency of others being active, and safety varied widely with means of 3.07, 3.25, 3.62, 3.34, 3.04, and 3.5, respectively. Fifty-three percent of participants reported not traveling outside their neighborhood when engaging in physical activities. The range of miles traveled among persons who were active outside their own neighborhood was 10-

75. In addition to formal questions about neighborhood characteristics, several participants also provided narrative comments about the lack of sidewalks in one community and difficulty getting outside in the winter.

Psychometric Properties of Measures

Descriptive analyses included means, standard deviations, skewness, kurtosis, and when appropriate, correlation of item to scale. Cronbach's alpha reliability scores were calculated for those scales with inter-related items, including the Social Support for Exercise Survey (family and friends), Index of Readiness, and the Index of Self-Regulation. Cronbach's alpha scores were compared to those reported in the literature.

Most items in the Perceived Environmental Support Scale addressing environmental characteristics and resources had normal distributions. However, the majority of participants responded to items inquiring about distance in miles from home to the place where most physical activity is performed and frequency of going to the park for walks and other activities with "0" and "not at all," respectively. This created limited variability and positive skew; skewness values were 2 and 1.95. Much of the missing data identified in the missing value analyses were within the Perceived Environmental Support Scale. For example, items addressing walking or being active with neighbors, streets being well lit at night, unattended dogs in the neighborhood, had missing values (1, 3, 3, respectively). Participants provided narrative explanations for not responding to these items with statements such as, "I don't have any neighbors," "There are unattended dogs, but I like them, they are part of the reason I go out," "There are

no unattended dogs, but there are unattended bears," and "There are no unattended dogs, but there are unattended wolves."

The majority of items in the Social Support for Exercise Survey had normal distributions. Items with limited distribution and skewness greater than 1.0 included (a) complaints related to time spent being active (family and friends), (b) criticisms of being active (family), (c) changing schedules to make it possible to be active together (family), and (d) asking for ideas about how to do more strength/balance activities or walking (family and friends). Most participants indicated that neither family nor friends complained about them or criticized them for participating in physical activities. Similarly, family and friends rarely asked for ideas about how to become more active themselves. Families were not likely to change their schedules to do activities together or to plan activities around participant's activity schedules. Total scores for the Social Support for Exercise Surveys related to family and friends were normally distributed. The Cronbach's alpha values for Social Support for Exercise Survey related to family and friends were a = .805 and a = .826 respectively.

Self-knowledge was evaluated using the Possible Selves Questionnaire and the Goal Attainment Scale. The Possible Selves Questionnaire items addressing self-efficacy and expected outcome had normal distributions. Outcome values for goals identified also had normal distribution patterns.

Items in the Index of Readiness were normally distributed with the exception of the item stating, "I am willing to make sacrifices in order to participate in strengthening/balance activities and walking on a regular basis."

The mean and standard deviation of responses for this item were 3.73 (1-5 scale) and .69, with a skewness of 1.261. The total score for the Index of Readiness was normally distributed; with a Cronbach's alpha of a = .592. Cronbach's alpha scores for three Index of Readiness subscales (re-evaluation of lifestyle, identification of barriers, and goal commitment) were a = .329, a = .272, and a = .733, respectively. When item 3, "I think that I need to change some of the things that keep me from participating in strengthening/balance activities and walking," was removed from analysis, Cronbach's alpha for the total score increased to a = .635. Despite poor reliability, analyses included the IR as designed, to make meaningful comparisons to previous research.

Individual items and the total score in the Index of Self-Regulation were normally distributed. Cronbach's alpha for the Index of Self-Regulation was .819.

The CHAMPS survey responses included 0 values, indicating that participants did not engage in those particular activities. Items that represented activities uncommon to participants did not have normal distributions such as shooting pool or billiards, golfing, playing tennis. However, subtotal activity times of sedentary, low-light, high-light, total light, and total activity (all light or moderate activity minus sedentary activity) were normally distributed. The majority of participants reported no or low frequency and durations of moderate-vigorous activity creating an abnormal distribution. Means, standard deviations, and skewness values of moderate-vigorously intense activities were 2.4, 4.1, and 13.7, respectively. Variables used in ANOVA analyses included scores for

duration (minutes/week), total activity, and light intensity activity. A common observation participants made about this survey was that it increased their awareness of the seasonality of certain activities. The interviews were conducted in fall and winter. While most participants reported they had not done heavy gardening, walking for leisure, or swimming in the last month, a few indicated they only do those activities in the summer. Other than skating, some participants also noted that many winter activities were not on the survey such as shoveling snow, ice fishing, and snowshoeing.

Accelerometer data had normal distribution with the exception of positively skewed data among WMI group participants at TI. Untransformed data was used in the analysis report because it was in the original metric and analyses with transformed and untransformed data were similar.

The majority of items constituting the functional measures of balance and strength had normal distributions. The Berg Balance Scale activities of standing unsupported with one foot in front of the other and standing on one leg were difficult for most participants. Therefore, scores for these items were positively skewed, with standard deviations greater than mean values and skewness slightly greater than 1. Berg Balance Scale total scores were normally distributed. The Up and Go Test, a one-item test, had a mean of 15 with a standard deviation of 4.4 and skewness of 1.2. The items in the Short Physical Performance Battery were normally distributed with the exception of the "side by side" stand, which most participants were able to perform for the full 10 seconds. Therefore, this

item was negatively skewed (skewness = -2.8). The summary score for the Short Physical Performance Battery was normally distributed and used for analyses.

Table 8 presents the correlation matrix of surveys used at baseline (T1).

Specific Aim 1. The first aim in this study was to examine the feasibility of the WMI among rural, community dwelling older adults evaluated for acceptability, demand (attrition and attendance rates), and implementation fidelity.

***Acceptability*.** Acceptability of the WMI was measured using survey and field notes. Participant evaluation of the WMI included five questions (four using a 5-point scale, one open-ended) eliciting satisfaction with the WMI content and suggestions for future WMI programs. Participant evaluation of Ready~Steady, the technology augmenting the WMI, included seven questions (six using a 5-point scale, one open-ended) eliciting learnability, satisfaction, and effectiveness. Additionally, field notes were also reviewed.

WMI acceptability evaluation. Most participants in the WMI group rated the following aspects of the program as very effective or effective: (a) explanation of the program's orientation and content (100%), (b) specific strategies used to support existing behaviors (93%), (c) specific strategies used to develop new ideas or behaviors (100%), and (d) specific strategies used to create realistic changes in life (100%). On a 5-point scale ranging from 1 (not at all effective) to 5 (very effective), mean scores were 4.68, 4.53, 4.64, and 4.56, respectively.

Table 8

Correlation Matrix of Surveys at Baseline

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Social Support (Fam)	1.0												
2. Social Support (Fr)	.40*	1.0											
3. Index of Readiness	.55**	.34	1.0										
4. Index of Self-Regulation	.65**	.45*	.65**	1.0									
5. Self-Efficacy	.25	.13	.17	-.02	1.0								
6. Outcome Expec-tancy	.55**	.13	.57**	.29	.37*	1.0							
7. Goal Attainment Scale	..26	.38*	.25	.36*	-.12	-.01	1.0						
8. CHAMPS: Total activity / wk	-.24	.16	.14	-.03	-.15	-.16	.29	1.0					
9. CHAMPS: Light activity/wk	-.26	.13	.09	-.08	-.15	-.17	.26	.97**	1.0				
10. Acceler-ometer: minutes /day	.04	.12	.09	-.14	.09	.26	.03	.23	.15	1.0			
11. TUG Time	.06	-.26	-.16	-.02	-.33	.24	-.11	-.33	-.28	-.48*	1.0		
12. SPPB Total	-.26	..23	.04	.01	.19	.07	.01	.16	.64**	.44*	-.64**	1.0	
13. BBS Total	-.098	.14	.15	.02	.37*	.23	.01	.27	.19	-.40*	-.73*›	.69**	1.0

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Narrative responses to the survey and review of field notes implied that the program helped improve their physical function; gain an understanding that physical activities improve strength, balance and function; and realize that through individualization, the physical activities promoted in the WMI can be achieved by everyone. Most participants commented about ways in which their physical function was improving such as, "It is easier to get out of a chair," "It is easier to move around," "This improved my balance," and "I climbed a flight of stairs for the first time in a year." Several participants become more aware of habits and beliefs that limited their physical activity. For example, one participant realized that she continued to restrict her physical activities two years after knee surgery. She said, "I realized I have been babying myself, so I am working on increasing my minutes of activity. Instead of getting out of the chair once for many chores, I am getting out of the chair for each chore." Another woman shared, "I grew up on a farm where we always thought retirement meant rest, now I think if you don't move it you lose it, and it just goes away." The WMI helped participants develop strategies and plans for integrating more activity into their everyday lives. One woman shared, "I think better of myself now; I get up every morning and do a few of my exercises while the coffee is brewing." Another shared, "I am more active; every time I talk on the phone (and I am on the phone a lot) I walk throughout the house." Field notes also revealed that several participants indicated they valued the social connections and support they experienced during the study group sessions. Suggestions for improving the program included meeting twice weekly, extending the program beyond eight

weeks, and incorporating arm exercises into the program. Finally, several participants and community members suggested persons younger than 74 could also benefit from the program. Most group session guests were between the ages of 60 and 72.

Ready~Steady app usability and acceptability. Most participants in the WMI group agreed or strongly agreed with items measuring the usability (e.g., is it learnable, satisfying and effective) of Ready~Steady, the accelerometer and persuasive technology app integrated into the WMI:

- I would use Ready~Steady/the iPod touch® to monitor my activity (80%).
- Using the Ready~Steady/iPod touch® to monitor my activity seems easy (100%).
- The functions on Ready~Steady/the iPod touch® are easy to use (100%).
- Most people could easily learn to use Ready~Steady/the iPod touch® to monitor physical activity (100%).
- Wearing the iPod touch® was comfortable (93%).
- I received valuable information on my levels of activity by using Ready~Steady/the iPod touch® (93%).

On a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) mean scores of these questions were 4.2, 4.46, 4.46, 4.46, 4.53, and 4.53, respectively.

The narrative responses to an open-ended question about suggestions for improving the technology were categorized as comments about how to improve Ready~Steady, learning to use Ready~Steady, and wearing and using Ready~Steady. During group session conversations, several participants requested that battery life be extended beyond 14 hours. The majority of participants felt the Ready~Steady app worked well. Narrative comments included, “It works fine for me,” “I never thought about any improvement,” and

"It does more than I expected it to do." There was a "learning curve" for using Ready~Steady, yet the majority of participants in the WMI felt it was relatively easy to learn. Comments about learning to use Ready~Steady included, "Anyone can use this," "Anyone can use this if I can," "I don't know anything about computers and I learned to use it." The majority of participants in the WMI wore the iPod touch® daily in a belt for small personal items and used the Ready~Steady app to view their activity levels and goal attainment. Participants commented that "the belt did not bother me," "I wore it everywhere," and "I did not know I had it on." One woman did not use the app to monitor her activity, as she felt her own "internal gauge" kept track adequately. Several others checked their Ready~Steady apps often as "incentive to keep going." For example, one man shared, "It surprised me, sometimes I felt I had probably met my goal, but found out I hadn't by looking at the monitor, then I would walk some more." Similarly a woman shared, "If I didn't meet my goals by 6pm, I would walk extra in the house." Another participant said it was a "reminder to keep moving," and fun to "compare and share numbers with others."

Field notes revealed information about learning to use Ready~Steady, attitudes about using a monitor, and time required to coordinate the technology in the WMI. Explicitly written instructions with illustrations demonstrating how to charge, activate, and wear the iPod touch® in the SPI belt were important aspects of initial orientation. Participants appreciated the instructive illustrations and the daily logs that provided cues for charging, wearing, and evaluating their progress. As mentioned previously, follow-up within 24-48 hours was also important for

reassurance and to review key instructions for use. Most participants sought instrumental assistance from others in their group, their friends, neighbors, or children when they needed help and then informed the PI about it the next day. Many participants showed their monitors to their physicians and family members and described positive responses. One participant said, "My doctor is so impressed with my monitor and activities." Two participants were unable to operate the monitor well enough to use it reliably every day. They had difficulty tapping the app icon lightly enough to open the program. They also had difficulty connecting the charging cord and fastening the SPI belt. Both attributed difficulties to decreased dexterity in their hands due to a previous bout of polymyalgia rheumatica and rheumatoid arthritis. One participant was unsure if she wanted to wear the monitor. She said, "I am not sure about this, I need to think about it and talk it over with my friends." She decided to wear it and later during discussions about how to keep track of physical activity, she said, "I just use the monitor." Field notes reflected time was required for programming monitors, providing instruction about Ready~Steady to individual participants, and managing data, but time logs were not kept.

Demand. Intervention demand, as indicated by attendance rates in study sessions and attrition rates, was similar among participants in the WMI and attention control groups. Figure 6 illustrates the proportion of enrolled participants attending each session by treatment group. Participants in the WMI group attended an average of 7.3 out of eight sessions. Fifty-three percent attended all eight sessions; 26.7% attended seven sessions; and 20% attended six

sessions. Reasons for not attending included illness, snow, competing time commitments, and forgetting. Participants in the attention control groups attended an average of 7.1 out of eight sessions. Thirty-two percent attended all eight sessions; 54% attended seven sessions; 8% attended six sessions; and 8% attended five sessions. Rationale given for missing sessions included doctor visits, illness, babysitting, traveling to a funeral out of state, and entertaining guests for the holiday. Guests were welcomed to WMI and attention control group sessions. Five of the six groups (three attention control, two WMI) included one guest at each session. Guests included spouses, neighbors, and friends who were interested in the content, but did not qualify for, or enroll in, the study.

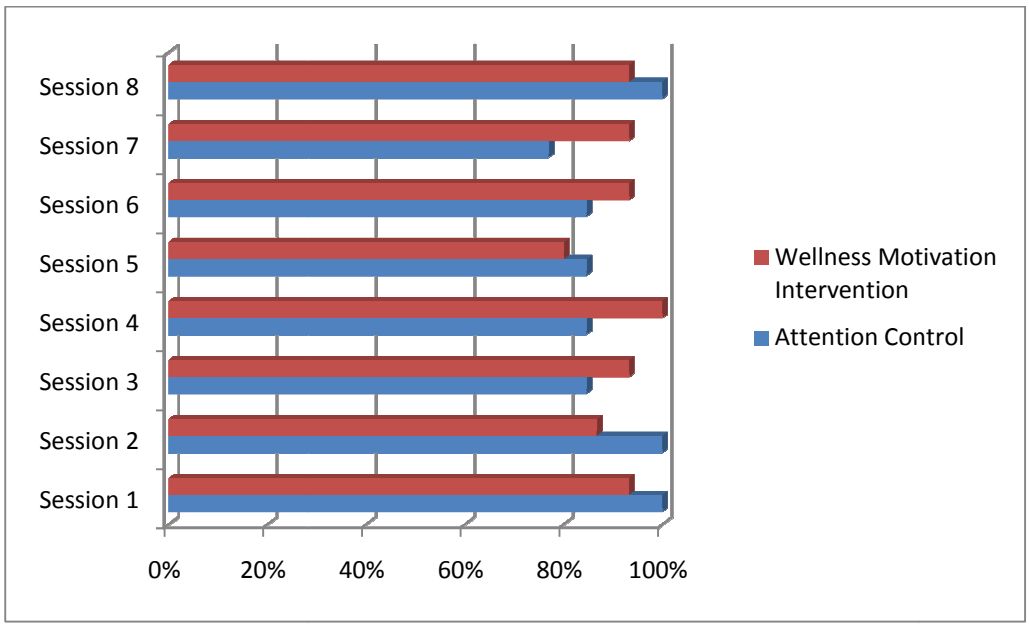

Figure 6. Attendance at WMI and Attention Control group sessions.

Two participants were lost to attrition (7%). One participant in the WMI group died from a chronic condition. Her daughter called the PI two weeks after her death explaining what happened. She also commented that her mother felt the program was important and had been excited about being part of it. Another participant dropped from the attention control group due to increasing caregiver responsibilities for her adult child, who developed a debilitating chronic illness. She was interviewed after missing three consecutive meetings. She was unable to attend group sessions, but said she was supportive of the program and would stay in touch.

***Implementation*.** Implementation fidelity of the WMI in a rural, community setting among persons over age 74 was evaluated through survey and observation. Each group session lasted approximately 90 minutes and included 4-7 participants, one guest, and the interventionist. The study was conducted from November 2011 through March 2012. Group sessions were not scheduled on holidays but continued weekly through the holiday season; overall one session was rescheduled due to a snow storm.

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 each part of the session was 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 gerontological nursing and trained in the WMI evaluated 25% of the sessions via audiotape. The interventionist's

evaluation results showed that sessions were delivered as planned very well 87% of the time and to a considerable degree 13% of the time. Rationale for delivering certain objectives to a considerable degree was due to limited time. At times groups were deeply engaged in a topic and took additional time to process that topic. For example, in a WMI group session 7, the discussion about "What makes being physically active satisfying now?" triggered a longer conversation than anticipated. One participant responded to this question with a story about how being active helps her to help others and helps others to help her. Her story inspired other participants in the group to reflect on their values. Each person shared their perspectives about how being active helped them to help others; they agreed that this was a value they shared. The evaluation results from the external reviewer showed that topics were delivered "very well" in all sessions reviewed. She also wrote narrative comments about participant engagement and session facilitation:

Attention Control Groups

- Participants shared knowledge of their own homeopathic remedies.
- Participants seemed very excited about discussing vitamins and supplements.

WMI Groups

- Participants volunteered suggestions and recommendations to others. A few verbalized self-reflection and insights about how to be more active.

- Participants identified barriers to physical activities like walking outside on slippery surfaces, icy sidewalks, cold weather, uneven pavement, sometimes having no motivation, and just bad weather.
- Conversations seemed relaxed, with a feeling of openness; there is trust.
- Interventionist was able to follow-up questions, validating responses, use of open-ended questions, encouraging members who are "quiet."
- Positive encouragements as motivation.

Specific Aim 2. The second aim in this feasibility study was to conduct limited efficacy testing of the WMI as increasing social contextual resources, behavioral change process variables, and behavioral and health outcomes among rural, community dwelling older adults. The following sections describe the results of repeated measures ANOVA examining changes over time in social contextual resources, behavioral change processes, and outcomes within and between WMI and attention control groups. Cohen's effect sizes are also reported. Where main effects or interactions were statistically significant, analyses of planned contrasts were conducted, with Bonferroni corrections to adjust for multiple comparisons.

Table 9 outlines the social contextual resources, behavioral change processes and outcomes in the WMI and attention control groups whose means were analyzed for change over time.

Table 9

Means and Standard Deviations of Theoretical Mechanisms and Outcomes

	Baseline (T1)				Eight Weeks (T2)			
	WMI (N=16)		Control (N=14)		WMI (N=15)		Control (N=13)	
Scale:	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Community Resources Identified/Used	n = 5		n = 4		n = 13		n = 5	
Social Support for Exercise (family) Total	33.81	8.7	36.64	8.94	30.43	6.58	35	6.14
Social Support for Exercise (friends) Total	28.06	6.83	29.79	9.23	36.46	6.27	32.85	8.55
Self-Efficacy	4.31	0.873	3.93	.43	4.46	0.74	4.23	0.59
Outcome Expectancy	3.84	1.15	3.96	0.69	4.26	0.70	4	0.82
Goal Attainment Scale	44.4	5.22	46.83	6.14	61.11	9.68	54.27	7.69
Index of Readiness Scale Total	30.88	3.86	31.57	3.79	34.93	2.60	32.54	4.22
Index of Self-Regulation Scale Total	28.13	4.65	30	6.2	36.06	3.79	29.23	5.09
CHAMPS Total Activity hours/week	36.09	.91	35.47	18.67	47.2	11.20	36.56	13.96
CHAMPS Light Activity hours/week	34.64	14.54	31.91	14.46	44.77	10.97	36.04	13.39
Accelerometer Light minutes/day	110	48	145.6	70	138.1	48	120.7	45
Berg Balance Scale Total	42	6.19	41	9.45	45.73	3.37	39.46	8.75
Short Physical Performance Scale Summary	5.38	1.54	5.86	2.79	7.73	1.58	6	2.31
Up and Go Test (seconds)	14.5	3.8	14.53	5.27	12.69	2.88	17.69	9.07

Theoretical Mechanisms of Change

Social contextual resources. Social contextual theoretical mechanisms of change included social support and perceived environmental resources.

Social support. Social support was measured using the Social Support for Exercise Scales for family and friends. Analyses for the mean scores of perceived social support from family changed over time among study participants F (1, 25) = 6, p = 0.021. Follow-up analyses revealed that these changes were due to decreased survey scores among WMI group participants that was borderline statistically significant F (1.26) = 3.6, p = .057, and statistically insignificant among attention control group participants.

Analyses for the mean scores of perceived social support for physical activity from friends revealed change over time among study participants, F (1, 27) = 9.7, p = .004. Follow-up analyses of simple effects indicated that these changes were due to increases in mean survey scores that were statistically significant among WMI group participants, F (1, 27) = 11.4, p = .002 and statistically insignificant among attention control group participants. Cohen's effect size (*d* = .48) is consistent with a small to moderate practical importance of the WMI's influence on perceived social support for physical activity from friends.

Perceived environmental resources. Awareness and use of community resources among WMI and attention control group participants were observed descriptively. The number of WMI group participants reporting the use of community resources increased over time: 5 (baseline) versus 13 (eight weeks).

The number of attention control group participants who reported using community resources remained similar: 4 (baseline) versus 5 (eight weeks). The most commonly used resources were community centers and department stores (e.g., L&M, Wal-Mart, Target). Hallways at home and in the local healthcare center and an exercise video were also used. More participants in the WMI group used community centers and department stores at week 8, when compared to baseline and to the attention control group.

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

Self-knowledge. The self-knowledge concept was measured using the Possible Selves Questionnaire and the Goal Attainment Scale. Content analysis was conducted for the three open-ended questions in the Possible Selves Questionnaire; feared selves, related goals, and activities. Eight categories of feared selves were identified from baseline data related to mobility changes (30%), cognitive dysfunction (7%), social dysfunction (3%), nutrition (underweight and overweight) (7%), chronic conditions (e.g., atrial fibrillation, heart failure, arthritis) (23%), pain (3%), and wellness (16%). Wellness was identified as a category for individuals who preferred to frame their thoughts about health as hopes rather than fears. For example, when one participant was asked, "List one health problem that bothers you the most or that you think needs improving," she explained that, "I have many problems that I attend to with help from my doctor and nurses, but I don't think or worry about those. I focus on staying well; my focus is on staying active and being involved with my friends

and this community." Another participant explained that she concentrated on staying well so that she could continue to help her friends and neighbors. Her related goals and activities were to "Stay well, walk daily, finish making a quilt in the next month, and maintain a positive attitude." Many participants had baseline goals related to their feared selves that were nonspecific. For example, some participants indicated they would like to lose weight or stay active or stay busy. On a scale ranging from 1 (not at all able) to 5 (certainly able), participants rated their self-efficacy, or ability to carry out desired activities, as "maybe" (20%), "probably" (47%) and "certainly" (33%). On the same 5-point scale, participants rated their outcome expectancy, or ability to meet targeted goals, as "not at all" (3.3%), "maybe" (27%), "probably" (40%), and "certainly" (30%).

Categories for feared selves were similar at eight weeks to categories at baseline: mobility (21%), social function (4%), nutrition (4%), chronic conditions (39%), pain (7%), wellness (11%), and advance care planning (7%). Advance care planning was a new category at week 8, which reflected the concerns of two participants who were thinking about their plans for the future should they need additional help or die. Goals among WMI participants were more specific when compared to baseline, whereas goals among attention control participants remained general. For example, one goal of a WMI participant was, "I want to be able to walk a mile by July 2012." A goal of an attention control group participant was, "I want to start exercising more." There were no significant interactions or main effects for time or group on self-efficacy and outcome expectancy items. Cohen's effect sizes for both items (d = .34) are consistent

with small practical importance of the WMI's influence on self-efficacy and outcome expectancy.

The theoretical mechanism of self-knowledge was also measured using the Goal Attainment Scale. Analyses comparing standardized Goal Attainment Scale scores indicated significant group by time effects F (1, 27) = 8.4, p = .007. Follow-up analyses of simple effects revealed statistically significant increases in standardized Goal Attainment scores among attention control group participants, F (1,27) = 9.03, p = .006 and WMI group participants, F (1,27) = 55.9, p = .000 These changes are illustrated in Figure 7. Cohen's effect size (*d* = .78) is consistent with a moderate practical importance of the WMI's influence on goal attainment.

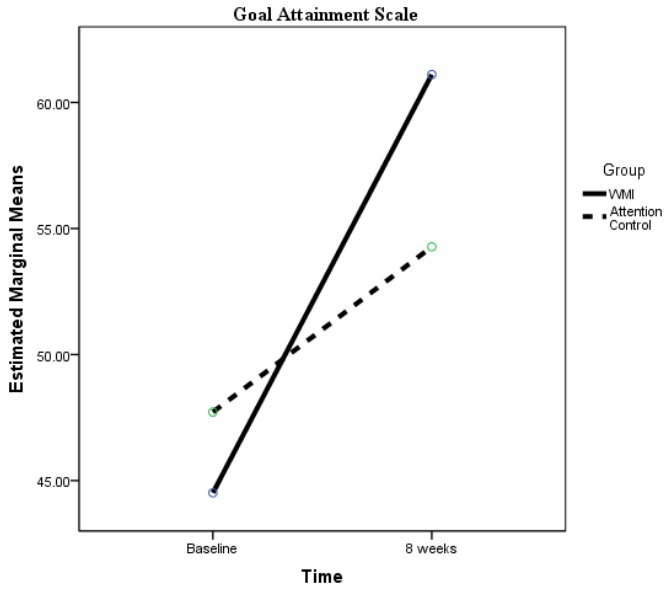

Figure 7. Effects of the WMI on Self-Knowledge.

Motivation appraisal. The theoretical mechanism, motivation appraisal, was measured using mean Index of Readiness scores, which changed over time among study participants, F (1, 26) = 9.3, p = .005. Follow-up analyses revealed these changes were related to increases in mean Index of Readiness scores that were statistically significant among WMI group participants, F (1,27) = 9.34, p = .005 and statistically insignificant among attention control group participants. These changes are illustrated in Figure 8. Cohen's effect size (*d* = .68) is consistent with moderate practical importance of the WMI's influence on motivation appraisal.

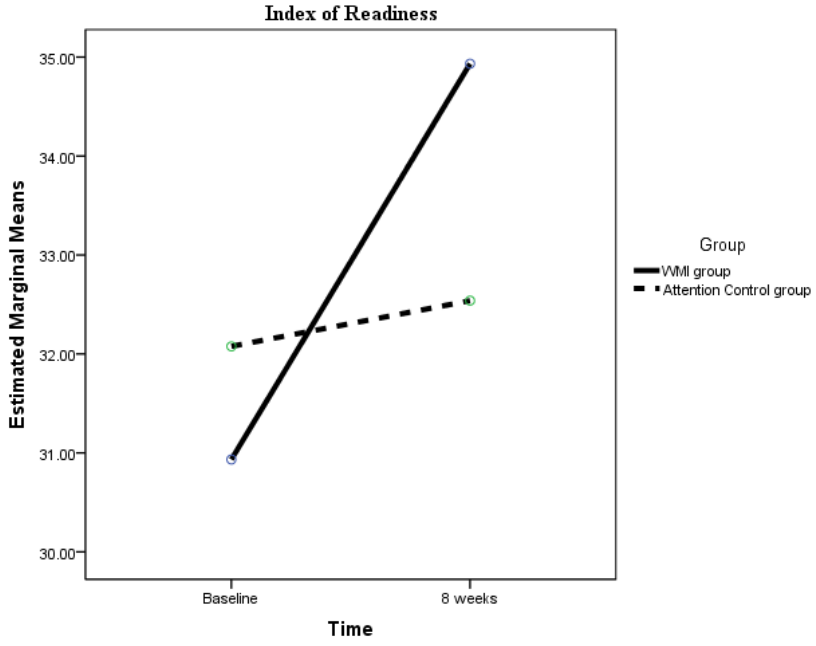

Figure 8. Effects of the WMI on Motivation Appraisal.

Self-regulation. The theoretical mechanism of self-regulation was measured using the Index of Self-Regulation. Analyses comparing mean Index of Self-Regulation scores indicated significant group by time effects, F (1, 26) = 26.7, p = .000. Follow-up analyses of simple effects revealed statistically significant increases in Index of Self-Regulation scores among WMI group participants, F (1,26) = 38.8, p = .000 and statistically insignificant decreases among attention control group participants. These changes are illustrated in Figure 9. Results indicate that WMI participants developed self-regulation strategies for enacting strength, balance, and walking behaviors, overcoming barriers, and self-monitoring. Cohen' effect size (*d* = 1.52) is consistent with a large practical importance of the WMI's influence on self-regulation.

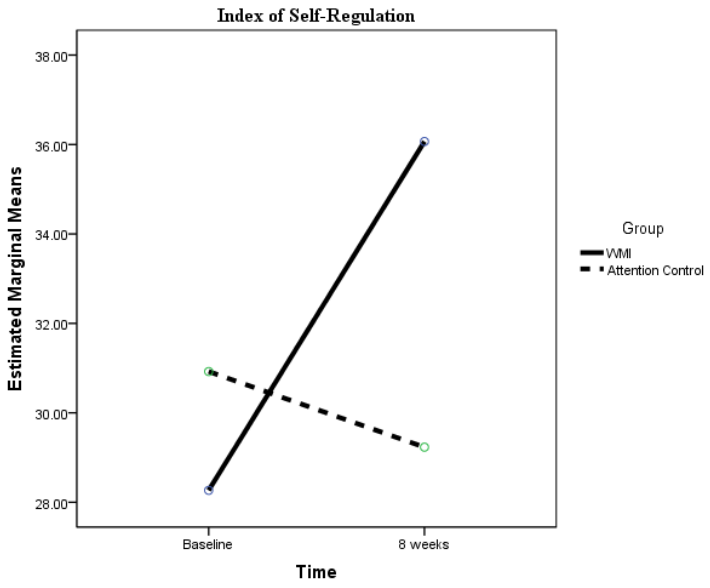

Figure 9. Effects of the WMI on Self-Regulation.

Outcome Variables

Behavioral outcome variables. Physical activity behavior was measured subjectively and objectively using the CHAMPS survey and accelerometer data, respectively. Light intensity physical activity was the focus of analysis in this study for two reasons (a) physical activities promoted in this WMI were of light intensity, and (b) both CHAMPS survey results and accelerometer data revealed that most participants engaged in light intensity physical activity. Table 10 reports the Spearman rank-order correlations between CHAMPS and accelerometer variables analyzed. At baseline (T1), there was a small, positive, non-significant correlation ($p = .25$, $P > .05$) and a moderately strong, positive, statistically insignificant correlation ($p = .33$, $P > .05$) between accelerometer activity and CHAMPS light and total activity respectively. At follow-up (T2), the correlation between accelerometer activity and CHAMPS total activity was moderately strong and statistically significant ($p = .41$, $P < .05$).

Analyses comparing the mean hours of activity per week (light, moderate and vigorously intense) estimated by the CHAMPS survey indicated significant group by time effects, $F (1, 26) = 5.1$, $p = 003$. Follow-up analyses of simple effects revealed that over time, WMI group participants reported engaging in more physical activities, $F (1,26), 11.92$, $p = .002$, while reports from attention control group participants did not change significantly. These changes are illustrated in Figure 10. Cohen's effect ($d = .84$) is consistent with a moderate to large practical importance of the WMI's influence on total physical activity per week as measured by CHAMPS.

Table 10

CHAMPS and Accelerometer Correlation Matrix

Variable	1	2	3	4	5	6
1. Light Activity: CHAMPS T1	1.00					
2. Light Activity: CHAMPS T2	.72**	1.00				
3. Light Activity: Accelerometer T1	.25	.16	1.00			
4. Light Activity: Accelerometer T2	.27	.38	.279	1.00		
5. Total Activity: CHAMPS T1	.98**	.67**	.33	.37	1.00	
6. Total Activity CHAMPS T2	.68**	.97**	.11	.41*	.66**	1.00

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

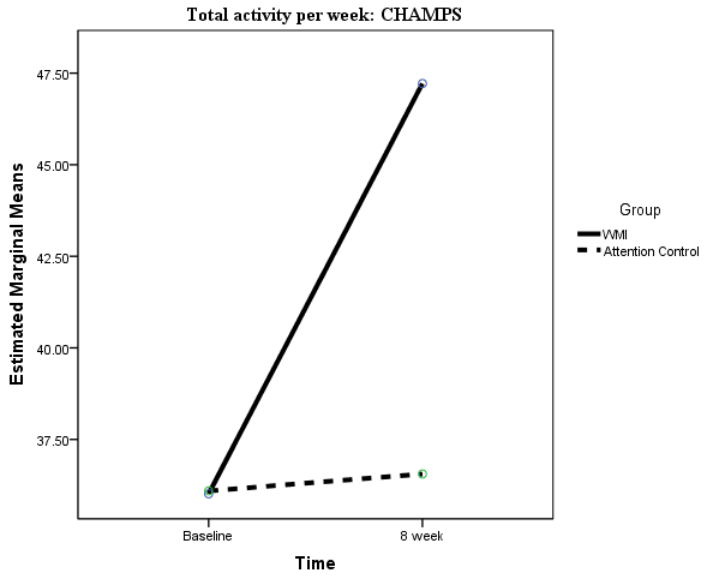

Figure 10. Effects of the WMI on self-reported physical activity behavior: CHAMPS (light intensity combined with moderate/vigorous activity).

Analyses comparing the mean hours of light intensity activity per week estimated by the CHAMPS survey revealed that there was change over time among study participants F (1, 26) = 12.6, p = 002. Follow-up analyses revealed these changes were related to reports of increased hours of light intensity activity per week; statistically significant among WMI group participants F (1, 26), 14.9, p = .001, and statistically insignificant among attention control group participants. These changes are illustrated in Figure 11. Cohen's effect (*d* = .95) is consistent with a moderate to large practical importance of the WMI's influence on the quantity of light intensity physical activity behavior as measured by CHAMPS.

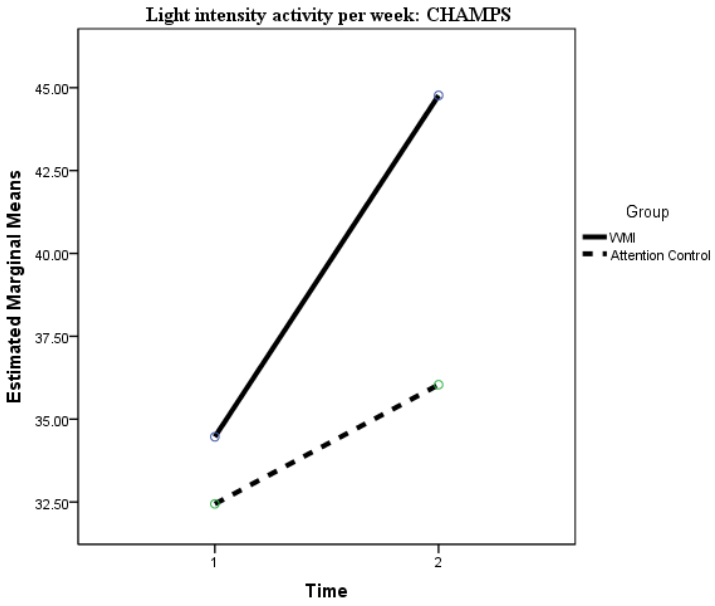

Figure 11. Effects of the WMI on light intensity physical activity behavior: CHAMPS.

Accelerometer data used for analysis represents days when participants wore the accelerometer for 8-14 hours over the course of 4-7 days. Analyses comparing the mean minutes of activity per day (light intensity) estimated by the accelerometer in Ready~Steady indicated significant group by time effects, F (1, 24) = 10.37, p = .004. The p-value for this interaction became borderline significant when the data were transformed. Follow-up analyses of simple effects revealed statistically significant increases over time in mean minutes of daily activity among WMI group participants, F (1,23) = 11.4, p = .003 and insignificant decreases among attention control group participants. These changes are illustrated in Figure 12. Cohen's effect (*d* = .60) is consistent with moderate practical importance of the WMI's influence on minutes of physical activity per day as measured using accelerometry.

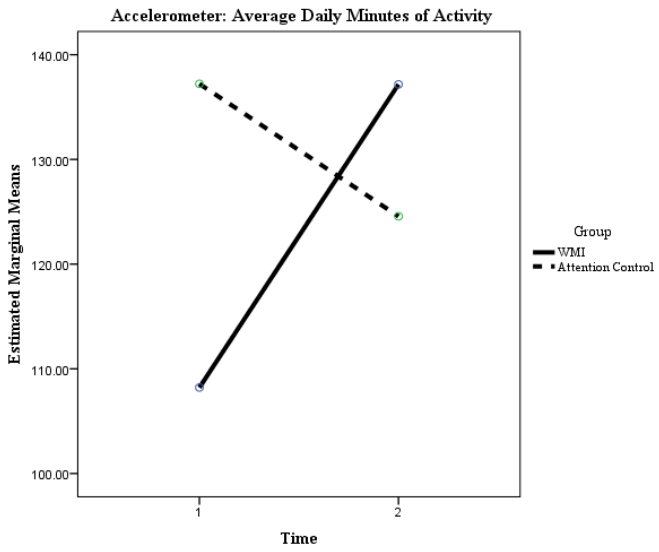

Figure 12. Effects of the WMI on the minutes of light intensity physical activity per day: Accelerometer.

Health outcome variables. Health outcomes were measured using the Berg Balance Scale, the Up and Go test, and the Short Physical Performance Battery. Levene's test of variance equality was significant in follow-up measures (T2) of the Berg Balance Scale, the Up and Go, and the Short Physical Performance Battery, requiring analyses using unequal-variance marginal models for repeated measures ANOVA through SAS 9.2, PROC MIXED. Results were similar in both analyses.

Analyses comparing mean scores on the Berg Balance Scale indicated significant group by time effects, $F(1, 26) = 6.4$, $p = .018$. Follow-up analyses of simple effects revealed statistically significant improvements in mean Berg Balance Scale scores among WMI group participants $F(1,26) = 8.7$, $p = .007$ and lower scores among attention control group participants that were insignificant. Figure 13 illustrates these changes. Cohen's effect ($d = .94$) is consistent with moderate to large practical importance of WMI's influence on static balance, measured using the Berg Balance Scale.

Analyses comparing mean summary scores of the Up and Go test indicated significant group by time effects, $F(1, 26) = 7.5$, $p = .011$. Follow-up analyses of simple effects revealed decreased (improved) Up and Go times that were statistically insignificant among WMI group participants and statistically significant increases (worsened) Up and Go times among attention control participants $F= 6.1$, $p = .02$. Figure 14 illustrates these changes. Cohen's effect ($d = .73$) is consistent with moderate practical importance of WMI's influence on dynamic balance, measured using the Up and Go.

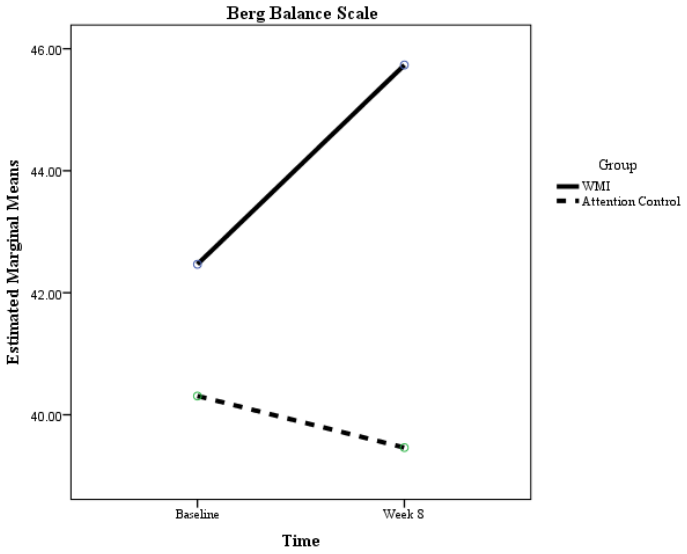

Figure 13. Effects of the WMI on the Berg Balance Scale.

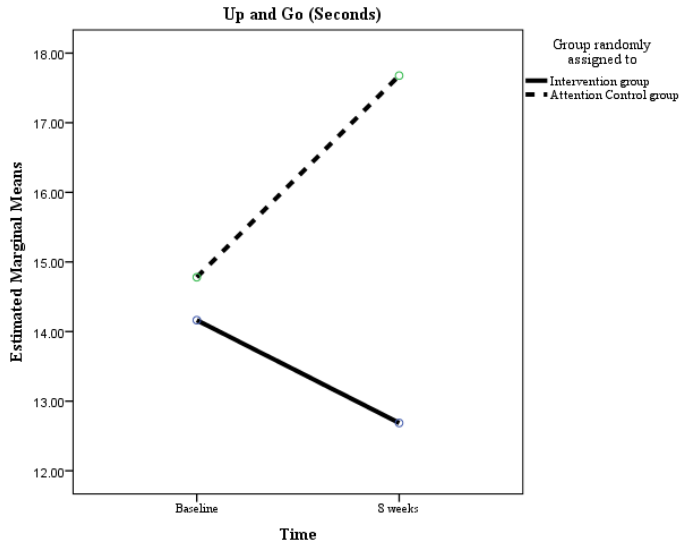

Figure 14. Effects of the WMI on the Up and Go.

Analyses comparing mean summary scores of the Short Physical Performance Battery indicated significant group by time effects, F (1, 26) = 6.7, p = .016. Follow-up analyses of simple effects revealed statistically significant improvements in mean summary scores among WMI group participants, F (1,23) = 11.4, p = .003 and insignificant improvements among attention control group participants. Figure 15 illustrates these changes. Cohen's effect (*d* = .87) is consistent with a moderate to large practical importance of the WMI's influence on functional balance and strength, measured using the Short Physical Performance Battery.

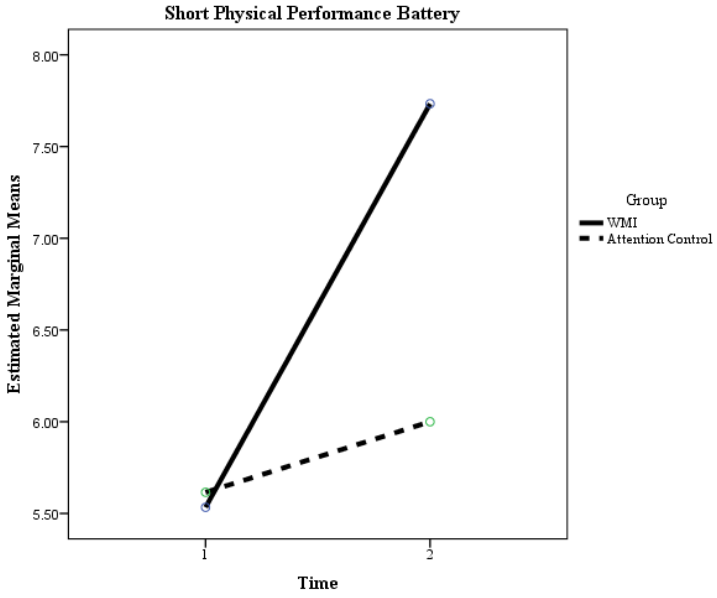

Figure 15. Effects of the WMI on the Short Physical Performance Battery.

Summary

Study findings supported the feasibility (acceptability, demand, implementation, limited efficacy) of the WMI in rural, community dwelling older adults. Acceptability surveys revealed both the WMI and the Ready~Steady app were found to be acceptable. There was a demand for the intervention as indicated by low attrition and good attendance. Results of repeated measures ANOVA using marginal models to evaluate changes in social contextual resources, behavioral change processes, and outcomes as a function of time, treatment group, and time by treatment group interactions, indicated that perceived social support from friends, use of community resources, motivation appraisal, self-regulation, light intensity physical activity, and functional balance and strength increased among WMI group participants when compared to attention control group participants. Perceived social support for physical activity from family decreased and goal attainment scores increased among participants in both WMI and attention control groups.

Chapter 5

DISCUSSION

This feasibility study supports the acceptability, demand, and implementation of the WMI among rural, community dwelling older adults, as well as the effects of the WMI on theoretical mechanisms of change (social contextual resources, behavioral change processes) and outcomes tested (health and behavior). These findings have important implications for theory, nursing science, future research, and practice. This chapter discusses findings within the contexts of falls prevention and geriatric nursing organized according to specific aims in this study. Strengths, limitations, and implications for theory, nursing science, research, and practice are highlighted.

Specific Aim 1

Acceptability. The WMI and integrated technology were evaluated as acceptable and usable by the rural, community dwelling older adults enrolled in this study.

***WMI acceptability*.** Based on participant evaluation and interventionist field notes, the content of the eight-week WMI was very acceptable. Acceptability findings in this study are similar to those reported in other WMI studies. Perez (2009) reported excellent acceptance of the WMI operationalized as IMPACTO among older Hispanic women at risk for heart disease. While acceptability has not been systematically reported in fall-preventive physical activity interventions (McMahon & Fleury, 2012a), it is an important element to evaluate in research and practice (Bowen, et al., 2009). Understanding participant

acceptance of interventions (e.g., to what extent it is suitable and satisfying) is critical for intervention development, testing, sustainability, and translation to practice.

Ready~Steady usability and acceptability. The Ready~Steady app within an iPod touch® was evaluated as learnable, satisfying, and effective among some older adults, particularly when 1:1 directions for use were provided and supplemented with clear, concise, and illustrated written instructions. While many older adults do not currently use mobile computer technology (Smith, 2011), some may be interested and open to learning new ways of encouraging increased physical activity. This is congruent with the pilot study conducted on the Ready~Steady app (McMahon, Vankipuram, Hekler, & Fleury, 2012) and current literature suggesting older adults effectively use health related computer programs, apps, and Internet sites that are personally meaningful (Alicea-Planas, Neafey, & Anderson, 2011; Chisnell, 2006; Winter et al., 2012). Participants in the WMI noted that Ready~Steady motivated them to be physically active, which is consistent with previous research suggesting that health promotion apps increase physical activity and decrease sedentary time (Hekler et al., 2012). Understanding the acceptability and usability of the Ready~Steady app in this population provides support for further development and testing of technology designed to augment the delivery of critical content within theory-based interventions.

Demand. In this feasibility study, demand was very good as evidenced by high attendance rates and low attrition rates. Participants in this study missed

meetings for reasons related to personal health (e.g., illness, doctor visits) and personal schedules (e.g., entertaining family for the holidays). Attrition in this study (7%) was low compared to other studies in this field. In a review of fall prevention physical activity interventions (McMahon & Fleury, 2012a), attrition rates ranged from 1% (Iwamoto et al., 2009) to 60% (Voukelatos et al., 2007) due to illness, lack of transportation, lack of motivation, relocation to a nursing home, death, inconvenient schedules, and non-adherence to recommended interventions (Barnett et al., 2003; Binder et al., 2002; Day et al., 2002; Haines et al., 2009; Hauer et al., 2001; Kita et al., 2007; Logghe et al., 2009; Means & O'Sullivan, 2005; Robertson et al., 2001; Robitaille et al., 2005; Skelton et al., 2005). Attrition in this study was due to death and family illness.

Very good attendance and low attrition in this WMI study may have been influenced by: (a) offering an intervention that was meaningful and relevant to the target population; (b) research and theory-based messaging used within WMI recruitment, intervention delivery, and retention strategies; and (c) integrating community members' perspectives and preferences into the research protocol. Research conducted by Yardley and colleagues (2005, 2007) note that fall programs framed as addressing "fall risk" elicit concerns from older adults about the negative connotations of being labeled a "faller," which may create social stigma and contribute to ageism. Suggestions include positively framing messages about program content by emphasizing the benefits of participation (e.g., health, independence) rather than deficits warranting participation (e.g., fall risk, being a faller). Messaging strategies used in WMI recruitment, critical

content, and retention materials emphasized wellness and individual strengths. The recruitment flyer for the study described the program as "designed to promote the health and wellness of older adults living in the community." The preventability of falls was also highlighted. Discussions about falls in the WMI were designed to explore individual perspectives of falls and their preventability. Emphasis was on the role of fall-preventive physical activities in fulfilling personally meaningful goals and values. Timing, location, and transportation for the WMI was guided by recommendations of community leaders and older adults in the communities served and were consistent with previous research describing preferences for community-based interventions (Hutton et al., 2009) and the need to provide transportation when needed (Calhoun et al., 2011; Roe et al., 2008; Snodgrass & Rivett, 2005).

Implementation fidelity. The WMI in this study was delivered as planned. The manualized intervention, including lists of standard supplies for each meeting, ensured the interventionist and site were well prepared for each session. Fidelity to intervention delivery, receipt and enactment through field notes, the Index of Procedural Consistency, and an external review provided opportunities for the PI and research team to correct drift from the protocol throughout the study. In future WMI development, creating explicit participatory interventionist training methods and documentation will facilitate building WMI related competence among nurses, other disciplines, and community leaders (Frank, Coviak, Healy, Belza, & Banghwa, 2008). Continuing to refine fidelity monitoring will facilitate WMI replication in future research and provide a

foundation for developing a continuous quality improvement system when the WMI is translated into practice (Frank et al., 2008). Understanding intervention fidelity is critical to valid interpretation of research results, and for improving the application of the intervention in future research and practice (Bellg et al., 2003; Glasgow & Emmons, 2007; Sidani & Braden, 1998).

Specific Aim 2

Theoretical mechanisms of change.

Social contextual resources. Increased perceived support from friends for physical activity among WMI group participants at eight weeks (T2) when compared to baseline (T1), indicates that intervention critical content targeting social network support positively influenced social support between friends. The WMI was designed to increase social support (Perez & Fleury, 2009) as it is a known determinant of physical activity behaviors among older adults (Resnick, Orwig, Magaziner, & Wynne, 2002; Wilcox et al., 2000). Field notes from WMI group sessions revealed that as the study progressed, group participants provided support including words of encouragement and recognition. In some cases participants connected between group sessions to walk together. Now, three months post study, one group continues to meet weekly to visit and practice the balance and strength activities they learned together.

Perceived social support for physical activity from family decreased in both the WMI and attention control groups, which may reflect physical distance between family members as well as sensitivity to the types of family support sought by rural dwelling older adults. Many study participants live more than 100

miles from their family members and did not interact with them on a daily basis. Field notes indicated that family members were supportive of participants being active and joining the WMI study. One participant said, "My son brags to his friends about me being in an exercise club." Another said, "My daughter read over the wellness materials and was so impressed. She works at a large clinic and said she can't believe there is such a nice program, even way out in the sticks of Minnesota." A daughter of the WMI participant who died called the PI after the funeral and commented, "The wellness group is great. I think it would even help people with dementia." As the role of social support from friends and family remains on the research agenda for physical activity among older adults (Hughes, et al., 2011), further exploration of measures that are valid and reliable in this population is critical for continued theory and intervention development.

Participants acknowledged the presence of community resources including community centers, department stores in a nearby town that welcome walkers, and a healthcare center with long public corridors for walking. Use of these resources and strategies to improve resources changed over time. More participants in the WMI groups reported using these community resources at follow-up (T2) than at baseline (T1), when compared to participants in attention control groups. As the study ended, two study participants discussed plans for obtaining park benches along the main sidewalk in one town as a strategy to promote outdoor walking and activity. At the time of this writing, they continue to work on this process with the local city council and department of recreation. Community resources that positively influence physical activity behavior and

lower fall risk include safe and crime free neighborhoods, and access to facilities that promote activity such as sidewalks, walking paths, swimming pools, and walking tracks (Booth et al., 2000; Brownson et al., 2001; Masotti, Fick, Johnson-Masotti, & MacLeod, 2006; Rubenstein, 2006; Schutzer & Graves, 2004; Todd et al., 2008).

Behavior change processes. Behavioral change processes in the WMT include self-knowledge, motivation appraisal, and self-regulation, and 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 Possible-Selves Questionnaire and the Goal Attainment Scale. Participants described feared selves including the potential for functional changes (physical, social, and cognitive) and managing chronic conditions (e.g., hypertension, heart failure, cancer). None of the participants referred to fall or injury when reflecting on feared selves. Some participants were reluctant to focus on feared selves, explaining that while they were aware of their personal health issues, they preferred to focus on wellness. This indicates that participants, in addition to addressing feared selves, might find meaning in reviewing hoped for selves and related activities.

This study represented the first time using the Goal Attainment Scale as an additional measure of self-knowledge in the WMI. Use of the Goal Attainment Scale allowed participants to establish and then evaluate personal and specific goals related to fall risk (health, activity, safety, medications). Greater progress

toward attaining personally meaningful goals was made among WMI group participants when compared to attention control groups as indicated by Cohen's effect size (d = .78), suggesting a moderate practical importance of WMI's influence on goal attainment. However, group differences were not statistically significant. The change in fall related goal attainment (health, activity, safety, medication) among WMI group participants is congruent with previous research suggesting that the Goal Attainment Scale is sensitive to incremental change and is an efficient measure of health status among frail older adults (Rockwood et al., 1993). Findings are also congruent with Shearer, Fleury, and Belyea's (2010) research reporting that participants in a health empowerment intervention successfully attained their personally relevant goals. Findings support research (Riediger, Freund, & Baltes, 2005) and theory (Heckhausen, Wrosch, & Schulz, 2010) explaining that for many older adults, pursuing goals is priority, even in the face of multiple health concerns and life course transitions (Shearer et al., 2010). Using the Goal Attainment Scale and the Possible Selves Questionnaire to evaluate self-knowledge promises to broaden understanding of the role that personally relevant and valued goals have in promoting physical activity among older adults.

The concept of self-knowledge is central to the WMI as it provides a dynamic context for meaning through which individuals interpret new information, and establish goals and self- regulation strategies, while acknowledging hopes and fears about future health and gauging self-efficacy (Cross & Markus, 1991; Fleury & Sedikides, 2007). Self-knowledge is linked to

motivation for behavioral change and is the foundation upon which individuals develop their goals, interpretations, expectations, and plans (Fleury & Sedikides, 2007; Markus & Nurius, 1986). Self-knowledge evaluated with both the Possible Selves Questionnaire and the Goal Attainment Scale assesses self-relevant expectations and intentions, thereby increasing awareness and understanding of participant values, goals, perceptions of efficacy, and strategies for health behavior change. This understanding allows the interventionist to facilitate contextually relevant change by addressing representational processes (e.g., possible selves), evaluative processes (e.g., growth potential, self-efficacy, and goal expectation), and behavioral action (e.g., plans, negotiating social context, self-regulation) (Fleury & Sedikides, 2007).

Motivation appraisal. Motivation appraisal as measured using the Index of Readiness increased significantly in both WMI and attention control groups, however, the internal consistency of the measure used in this population was lower than expected, limiting statistical conclusion validity. Previous WMIs using the Index of Readiness as a measure of motivation appraisal report good reliability (Enriquez, 2004, 2009; Fleury, 1994; Perez, 2009) and a medium effect size (Perez, 2009). Items assessing a perceived need to re-evaluate lifestyles such as, "I don't participate in strengthening/ balance activities and walking as often as I feel that I could," and, "I think that I need to change some of the things that keep me from participating in strengthening/balance activities and walking," may have been interpreted by participants using broader conceptualizations of physical activities than used by researchers. One such discrepant conceptualization was

described by Calhoun and colleagues (2011). Study participants conceptualized physical activity as including simple activities of daily living (e.g., dressing), whereas researchers conceptualized physical activity as including moderate or vigorously intense activities. It may be that participants in this WMI study viewed themselves as currently active. They may not have felt a need to eliminate their current activities.

Another potential explanation may be related to perceptions of fall risk and the relevance of items on the Index of Readiness addressing lifestyle re-evaluation and overcoming barriers. Older adults often perceive their risk of falls differently than researchers and clinicians (McMahon, Talley, & Wyman, 2011). They may fear vulnerability (e.g. being labeled frail or a faller) (Berlin Hallrup et al., 2009; Roe et al., 2008; Yardley et al., 2006), focus on maintaining autonomy and independence more than calculating fall risk (Berlin Hallrup et al., 2009; Kilian et al., 2008; Yardley et al., 2006), or interpret risk as personally irrelevant (Horne et al., 2009; Kilian et al., 2008; Yardley et al., 2006).

Narrative data from WMI field notes provided insight into motivation appraisal. Over time, participants identified opportunities for adding strength, balance, and walking activities to their usual routines that involved sitting or standing. For example, one participant used a Kindle to read. She realized that in addition to sitting while reading her Kindle, she might be able to take breaks for leg strengthening activities (e.g., knee extensions). Others also re-evaluated their routines similarly, planning for new ways to stay active during everyday activities

such as sitting and standing. This supports that participants were able to plan for and add physical activity into their routines.

When discussing physical activity during WMI group sessions, participants identified barriers such as motivation, weather, feeling tired, having house guests, and having few local sidewalks, or benches to rest on when walking on the sidewalks. A wide array of strategies for overcoming barriers was suggested by participants during group discussions. Examples included self-talk such as this expression, "Using energy creates energy," and advice to self, such as, "Tell nagging person inside–No–I will not skip my exercise today." Many participants expressed that practicing physical activities in a social setting helped them overcome barriers by facilitating problem solving and identifying ways to "stay on track." One participant shared how she "takes her exercises" when guests are over, "at 2 pm I just go into my room and shut the door; they know not to bother me." Another woman explained that she does strengthening activities in the presence of her house guests; she invites them to join her. Most participants identified unique times and locations for engaging in strength and balance activities at home, based on their current routines and preferences. Strategies for walking more included taking walks with great grandchildren, walking with friends in the halls of the local healthcare center (stopping for lunch as a reward), walking in the department stores using a cart for support if necessary, and looking for a way to get more benches along the sidewalk in town (Deer River). In summary, study findings and field notes suggest readiness of participants in this

study did increase, but may require measurement refinement to better capture the experiences of rural older adults.

Self-regulation. Increases in self-regulation over time among WMI group participants were statistically significant, while decreases over time among attention control group participants were statistically insignificant. Means scores on items assessing self-monitoring and learning new habits and ways to stay active improved markedly among WMI participants. Self-monitoring informed several participants about their baseline physical activity behavior patterns. Some were surprised that their Ready~Steady apps did not show more minutes of daily activity. Participants also compared their "minutes" frequently with others in the group and with the interventionist. Comparisons triggered conversations during group sessions about the individuality of goals and progress. For example, one participant said, "She always has minute totals so much higher than mine, I feel bad." This participant came to a session later in the program and said, "I have been walking on the deck more and taking computer breaks, and I can see my minutes have really been increasing the last few weeks." Another participant viewed the monitor, commenting, "That is so great, you are really doing well." Field notes revealed that discussions about strategies for monitoring progress often centered on "checking the monitor." Participants in WMI groups discussed how each person's goals and minutes achieved were unique based on individual situations and preferences, and over time, they saw and evaluated progress in themselves and other group members. Personalized goals and rewards

emphasized in the WMI and augmented by the Ready~Steady app were theoretically relevant.

Field notes also revealed that initial plans to stay active during everyday activities evolved into learning new habits and ways to stay active. Many participants shared how they integrated knee extensions and ankle stretches into sitting activities (e.g., watching TV, working on the computer, or doing needlework). Several also explained how they integrated calf raises, side leg raises, one-leg stands, and heel-toe stands into standing activities occurring near a counter or chair (e.g., making toast or coffee, brushing teeth, watching TV, working on the computer). Finally, several participants also discussed how they integrated walking into everyday activities (e.g., walk while talking on the phone, walk extra steps when getting the mail, park in the furthest parking spot when at the store).

Self-regulation appears to be an essential element for increasing motivation for physical activities that reduce fall risk in older adults. Findings in this study are congruent with research in the area of self-regulation for behavioral change (Bellg et al, 2003; Umstattd et al., 2006; Umstattd, Wilcox, Saunders, Watkins, & Dowda, 2008). Findings also highlight the mutual processes of social network support and self-regulation (Brawley et al, 2003; Umstattd et al., 2006). Participants worked together to address over-protective others questioning the safety of their activities, overcoming new and changing barriers to being active, and supporting the unique personal goals and capacity of each participant. Intervention critical content that promotes self-regulation strategies should be

integral to research and practice in this field. Further exploration is needed to better understand how innovative use of persuasive technology (e.g., Ready~Steady app) (Fogg, 2003) adds value to intervention critical content and the WMI.

Outcomes

Behavioral outcomes. The WMI focused on increasing the activity levels of rural, community dwelling older adults that were not regularly active at levels recommended for reducing fall risk and promoting health (Garber et al., 2011). The WMI resulted in an increase in physical activity time among intervention group participants by an average of 28 minutes per day as measured by accelerometer; and 10 hours per week as measured by CHAMPS. The median number of hours per week spent engaging in calisthenics reported by WMI participants at follow-up (T2) was 1.8. Findings that physical activity behaviors increased among WMI group participants have important implications for developing the WMI and promoting physical activities that reduce fall risk. Few studies in this field have addressed motivation for the changes necessary to initiate and maintain these behaviors (McMahon & Fleury, 2012a). Findings in this study support combining strategies of promoting motivation for behavioral change (WMI) with proven physical activities (Otago) among rural, community dwelling older adults at risk for falls, and provide a basis for continued testing and translation into practice.

Findings were mixed regarding physical activity behavior among attention control group participants. The CHAMPS survey indicated attention control group

participant's hours of activity increased, but changes were not statistically significant. Conversely, accelerometer findings indicated attention control group participant's physical activity behavior decreased, but changes were not statistically significant. Discrepant findings may reflect limitations in subjective measures of physical activity including over reporting, double reporting and recall bias (Wilcox, Tudor-Locke, & Ainsworth, 2002; Jorstad-Stein et al., 2005). Strengths of self-report physical activity measures include their ability to assess specific activities. To further explore the CHAMPS item most representative of balance and strength activities promoted in this study, "How many total hours in a week do you do general conditioning exercises, such as light calisthenics or chair exercises?" was assessed study participants. Similar to other CHAMPS measures reported, both WMI and attention control groups reported changes over time in activities represented by this item, with increase over time being statistically significantly among WMI participants.

Findings that both groups reported increased activity, albeit increases among attention control groups were statistically insignificant, may be due to contextual factors including public education and programming around fall prevention. Fall rates in Minnesota are among the highest in the country, so the Minnesota Board on Aging and the Department of Public Health have made extensive campaign efforts to increase public awareness (Healthy Aging Minnesota, 2012; Minnesota Department of Health, 2007). The evidence for physical activity content in this intervention is established (Gillespie et al., 2009) and considered standard or usual practice (Stevens, 2010). Therefore, an

alternative approach to comparison group design in future WMI research is for control groups to receive usual care (instruction on proven balance and strength activities) and WMI groups to receive usual care plus critical content relevant to the WMT.

Accelerometer and CHAMPS data revealed that the intensity of physical activity performed by study participants was mostly light. This is congruent with research findings documenting the preferences of older adults for light activity (Westerterp, 2008). Additionally, the Otago protocol in this study emphasizes light intensity activity and there is growing evidence that these activities confer health benefits (Buman et al., 2010; Healy et al., 2007; Robertson et al., 2001). Data from this study support that older adults with increased fall risk have the capacity to increase physical activity behaviors safely.

Spearman rank-order correlations between objective and subjective physical activities were positive, moderately strong, and were statistical significant at follow-up (T2). Previous research has reported moderately strong, positive, and statistically significant correlations between CHAMPS and accelerometer measures (Hekler et al., 2012; Pruitt et al., 2008). The sample size in this study may have limited the ability to detect true significance of correlations observed throughout this study.

Health outcomes. Participants in the WMI groups practiced strength and balance activities up to three times per week (once in group session and twice at home) as guided by the Otago protocol (Gardner et al., 2001). Similar to research testing the Otago program (Gardner et al., 2001; Robertson et al., 2001), this

study found the protocol to be efficacious and safe among rural, community dwelling older adults at risk of falls. Participants in the WMI groups had significant changes in health outcomes measured as functional balance and strength (Berg Balance Scale, Up and Go, Short Physical Performance Battery) over time when compared to the attention control groups. None of the WMI or attention control group participants reported an injury. Among WMI group participants, total mean Berg Balance Scale scores improved over eight weeks, from 42 to 45.7. The WMI and attention control groups also differed in their change over time of dynamic balance as indicated by the Up and Go test. Among WMI group participants, total mean scores improved over eight weeks, from 14.5 to 12.7 seconds. These results are congruent with fall-preventive physical activity interventions lasting from two to 36 weeks (Binder et al., 2002; Inokuchi et al., 2007; Iwamoto et al., 2009; Li et al., 2005; Weerdestyn et al., 2009). The use of the Short Physical Performance Battery was chosen as an additional indicator of fall risk in this study because of its sensitivity to lower extremity strength variation seen in older adult populations. Short Physical Performance Battery summary scores improved among WMI group participants to a greater degree than those in attention control groups. Positive findings are congruent with fall prevention intervention research testing elements of this measure (e.g., repeated chair stands) (Inokuchi et al., 2007; Iwamoto et al., 2009; Sherrington et al., 2008).

While participants in the WMI groups improved functional balance and strength, this does not necessarily imply a reduction in fall rates. A recent meta-

analysis suggests that for a physical activity intervention to reduce fall occurrence, participants must engage in at least 50 sessions emphasizing balance (e.g., Otago protocol) (Sherrington et al., 2008). This feasibility study did not evaluate fall rates as an outcome. Measuring the impact of the WMI on fall rates is relevant for future testing with a larger sample size and longer follow-up periods.

Limitations

Limitations of this study included (a) small sample size, (b) limited testing of accelerometer energy output for validity in the field, and (c) inability to evaluate long-term maintenance of behavioral change and outcomes. The sample size of this study was small, limiting the generalizability of findings to populations outside rural Minnesota. Small sample sizes may also limit the ability to evaluate potential moderating variables.

While the accelerometer function in the Ready~Steady app measures varying intensities of physical activity for up to 14 hours each day, this and previous studies have suggested that research is still needed to establish methods for estimating unique energy expenditure representing sedentary, light, moderate, and vigorous physical activity among older adults (Buman et al., 2010; Copeland & Eslinger, 2009; Manohar et al., 2010; Murphy, 2009). Individual differences in fitness, function, and age can influence the energy expended for different activities (Ainsworth et al., 2011). For example, research examining accelerometer assessment in healthy adults over the age of 75 documents unique threshold estimations for moderate to vigorous activities (Copeland & Eslinger,

2009) that are lower than those established for young adults (Freedson et al., 1998). In this study, findings from initial prototype pilot testing were used to determine preliminary estimations for non-wear time, sedentary activity, light, moderate, and vigorously intense activity. Further differentiating sedentary, low-light, and high-light intensity activities, including leg strengthening and balance activities, will be especially helpful in this population (Buman et al., 2010; Hekler et al., 2012) as many older adults tend to prefer these and there is growing evidence that light intensity activity (Buman et al., 2010; Gillespie et al., 2009; Robertson et al., 2001) and decreased sedentary behavior improve health (Marshall & Ramirez, 2011).

This study was designed as a feasibility study and did not include evaluation for sustainability of WMI effects using longer term follow-up. Evaluation of sustainability is necessary for determining continued awareness and use of social contextual resources, behavioral change processes, and intended outcomes over time. Longitudinal study design combined with larger sample size will also enable researchers to evaluate sustainability of effects and target fall specific outcomes including fall occurrence.

Strengths

Strengths of this study included (a) a randomized design including older adults at risk for falls and analyses using principles of intent to treat, (b) use of a theory-based intervention, (c) use of community based research principles, and (d) integration of innovative technology. Increases in physical activity found in this randomized study, that were statistically significant and practically important,

support the idea that the WMI in similar populations of older adults may effectively increase motivation for physical activities that reduce the risk of falls. The randomized design allowed effect size estimations which are critical for future research in this area. Effect sizes of theoretical mechanisms (social contextual resources and behavioral change processes) ranged from .34 to 1.52 while effect sizes of outcomes (health and behavior) ranged from .36 to .95. A post-hoc power analysis for repeated measures ANOVA based on effect sizes found in this study indicated that future studies will need to enroll at least 90 participants, 45 participants per group, to yield 80% power, assuming 65% correlation between time points. In addition, future studies should plan on at least 7% attrition.

This intervention study is one of few in the field of falls prevention that has been guided by a theoretical perspective (McMahon & Fleury, 2012a). Development, testing, and translation of linkages between problems being studied, theoretical mechanisms, outcomes, and intervention critical content are facilitated through use of theory to guide intervention design, implementation, and evaluation (Lipsey & Cordray, 2000; Sidani & Braden, 1998). Without a theory to explain a problem of interest, theoretical mechanisms, outcomes, and their linkages, it is difficult to generate knowledge about what, when, where, for whom, and how an intervention works (Whittemore & Grey, 2002). Knowledge of these linkages is essential for research, continued theory development (Shearer, 2011), and translation into practice (Green & Glasgow, 2006). The use of the WMT in this study enabled clear and specific identification of the problem

addressed by the WMI. Rather than addressing general problems commonly identified in this field (e.g., inactivity, leg weakness and imbalance, or falls), this study addressed an underlying problem associated with the development, continuation, and duration of these general problems due to low levels of motivation (Sidani & Braden, 1998). Addressing the problem of increased risk of injurious falls among adults above the age of 74 due to decreased motivation for participation in physical activities that build leg strength and balance guided the identification of relevant theoretical mechanisms, outcome variables, and critical content needed in the intervention. The WMT also guided the design and integration of technology, the Ready~Steady app, used to augment the WMI.

The relevance of WMT concepts within communities targeted in this study is supported by literature reviews, and a concept analysis of wellness in older adults (McMahon & Fleury, 2012b). The relevance of the WMI and strategies needed for successful delivery among rural, community dwelling older adults in Itasca County communities was established through relationships with the community, not just individual potential research participants. Building community relationships included first gaining an understanding of, and respect for, community contexts (Minkler, 2000, 2003). Relationship development was consistent with basic principles of community partnership research (Clinical and Translational Science Awards Consortium, 2011; University of Minnesota [U of MN], 2012) including shared decisions about study implementation in the community. The research team was aware of and respectful of community interests and maintained openness to community member's ideas about how they

might benefit from the research or want to use the findings. Stakeholders, other than potential participants, were identified including the Agency on Aging, Elder Circle, and healthcare providers and administrators. Information about the study was presented to community stakeholders and potential participants during several different meetings and local events. Feedback regarding recruitment, study setting, and control group delivery was welcomed and integrated into the study protocol. Findings will be disseminated to stakeholders and participants after dissertation approval. Community-based research requires consideration of the risks and benefits to the stakeholder community as well as to the individual participant.

A key advantage of using a sensor within a mobile computer, where multiple functions are available within one device, is reducing user burden (King et al., 2012; Manohar, McCrady, Fujiki, Pavlidis, & Levine, 2010). The Ready~Steady app prototype was designed to enhance motivation for physical activities proven to reduce fall risk by augmenting WMI critical content linked to theoretical mechanisms of social contextual resources (social support, environmental resources), and behavioral change processes (self-knowledge, motivation appraisal, self-regulation). Theory-based mobile computer applications may be a promising adjunct to promoting motivation for physical activity in older adults.

Implications for Theory/Nursing Science

Findings from this study provide empirical support for the WMI in promoting wellness motivation among rural, community dwelling older adults as

explained by the WMT. This was the first study in the field of falls prevention to combine the WMI with physical activities known to reduce fall risk (Otago protocol). Results reinforce the dynamic roles of behavioral change processes and social contextual resources in personal wellness motivation patterns, promoting physical activity and fall risk reduction. It is within wellness motivation patterns that individuals address representational processes (direction for change and growth and construction of personal goals for health), evaluative processes (specifying goal expectations, potential for growth, self-efficacy) and behavioral action (mapping a guide for behavior, evaluation, and self-regulation) thereby fostering social contextual resources and transforming goals into desired outcomes (Fleury, 1996; Fleury & Sedikides, 2007). The primary focus on growth motivated behavior based on dynamic personal values within the WMT (Fleury, 1996; Parse, 1988) implies that a simple prescription or recommendation will not necessarily influence health related behavior. Instead, understanding motivational patterns viewed through the WMT, provides a basis for developing and testing personalized, individualized, and flexible approaches (Rogers, 1988; Shearer & Reed, 2011).

This feasibility study supports the applicability and effects of a strength based middle range nursing theory responding to a public health problem/deficit. The WMT reframes efforts to prevent falls through physical activity into efforts to promote motivation for physical activities proven to reduce fall risk that are consistent with personal values (Fleury, 1996). Empirical findings from this study support the theoretical explanation of how increasing motivation

(conceptualized as social contextual resources and behavioral change processes) for physical activity can contribute to increased physical activity behavior and better balance and strength among rural, community dwelling older adults. Findings from the study reinforce the accuracy and applicability of the WMT (Rothman, 2004), and they also support the need for further testing of the WMI.

The strength-based WMT builds upon traditional theories of motivation for behavioral 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 motivation for behavioral change emerged from cognitive schools of thought emphasizing the role of expectations in behavior (Heckhausen, 2000) and viewing behavior change (e.g., engaging in physical activities that reduce falls) as a linear process responding to a susceptibility, deficit, or threat (e.g., fall risk or fear of falls). The WMT moves beyond mechanistic worldviews to those reflecting unitary transformative worldviews where change is conceptualized as a patterning of human behavior in mutual process with the environment, consistent with how an individual wants to change (Butcher, 2012; Rogers, 1988), and their personal values and goals (Fleury, 1991, 1996; Parse, 1988). Congruent with unitary process models in nursing, the WMT does not explain a linear process of change in wellness motivation. Rather, it explains a continual patterning and evolution of developmental growth in mutual process with the environment (Parse, 1988). The WMI acknowledges that with age there is unlimited potential

for growth and that aging is a process of increasing diversity, creativity, and complexity (Butcher, 2012; Rogers, 1988). Further, the WMI acknowledges that in all phases of the life-span there are opportunities and constraints that shape goal selection and pursuit (Heckhausen, Schulz, & Wrosch, 2010). Individuals freely choose the personal meaning they assign to goals and change, thereby authoring their unique experiences of developmental growth (Parse, 1988).

Implications for Future Research and Practice

Future clinical trials with the WMI are needed, integrating design and methodologies that balance internal validity with external validity elements to foster translation of resulting knowledge into practice (Bowen et al., 2009; Glasgow & Emmons, 2007). Specific considerations for future research in this area include: (a) continuing close community partnerships consistent with community-based participatory research principles (U of MN, 2012); (b) expanding feasibility research (e.g., acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited efficacy) of the WMI in additional populations including persons with varying ethnicities, ages, and socioeconomic resources, who live in different environments (e.g., urban, congregate housing); (c) further evaluating the Ready~Steady app's ability to augment the WMI and measure physical activity; (d) examining the sustainability of WMI effects; and (e) employing innovative research design methods that help to optimize interventions for the greatest public health benefit (Collins et al., 2011).

The influence of social, economic, and political systems on health related behaviors is well known (Fleury & Lee, 2006; Stokols, 1982). Strong collaborative partnerships among researchers, clinicians, and community members will lead to development and testing of interventions which are both realistic and relevant (Baumbusch et al., 2008; Garnham et al., 2009; Hanson et al., 2006). In this feasibility study, community partnerships were considered to be basic (U of MN, 2012). Expanding these to form closer relationships will lay the ground work for developing a collaborative project with co-defined goals, balancing the benefit to the researcher and the utility for the community. Wellness motivation intervention testing could integrate an evaluation of communality partnerships and their influence on feasibility.

Concepts in the WMT and elements of the WMI support several research agenda items recommended by an expert panel reviewing the state of the science of physical activity in older adults (Hughes et al., 2012), including attention to (a) social support, messaging, and adherence; and (b) physical environments. Additional recommendations specific to physical activity and falls prevention include developing ways to measure broader level factors (e.g., community, organizational, policy) that influence initiating and sustaining motivation for behavioral changes (Hughes et al., 2011; Noonan, Sleet, & Stevens, 2011). Evaluation of the WMI across community settings, ethnic groups, and socioeconomic statuses will address health disparities due to lack of physical activity and provide a basis for translation to practice.

Ongoing research is needed to explicate the role of the Ready~Steady app in augmenting the WMI. Research is also needed to develop and test methods for identifying physical activity patterns and estimating energy expenditure of physical activity behaviors (Murphy, 2009; Welk, 2005, 2009) that are meaningful to both researchers and target populations. The use of technology in promoting health behavior change is relatively new, but offers an opportunity to reach across communities to provide motivational support in innovative ways.

Longitudinal studies will increase understanding of intervention adoption, implementation, and sustainability. Few interventions designed to address fall risk have included extended follow-up to evaluate sustainability of effects on physical activity behavior. Thus, it is unclear what is needed to sustain or optimize the effects of behavior change over time. Longitudinal evaluation of the WMI may address this issue, and allow measures of fall occurrence as an additional health outcome.

Multiphase optimization strategy is a methodological approach used in health related behavioral change interventions (Collins et al., 2011). This approach may be an efficient strategy for identifying WMI elements that are essential for effectiveness and efficacy. It will also clarify the cost effectiveness of the WMI. This approach emphasizes resource stewardship to guide the incremental development and optimization of an intervention and foster translation into real-world use (Collins et al., 2011).

Working together, scientists, theorists, and clinicians have the ability to develop interventions that reduce fall risk and the public health problem of falls.

Findings from this study have implications for practice including promise for further development of a strength-based intervention promoting wellness motivation among rural, community dwelling older adults, whose access to programs is limited. The WMI uses person-centered facilitation strategies that are manualized and potentially usable by nurses and other disciplines. Critical content promoting motivational support guides nurses and other interventionists to explore the personal health related hopes, fears, and values of participants as they develop and modify goals, action plans, and evaluation methods. Critical content in the WMI also emphasizes empowering education (e.g., identifying personal and community resources) and social network support, creating potential to impact community and organizational level factors influencing motivation for behavioral change.

Summary

In summary, this study supports the feasibility and efficacy of the WMI among rural, community dwelling older adults at risk of falls. Acceptability, demand, and implementation were very good. The WMI effectively increased theoretical mechanisms of change including perceived social support from friends for physical activity, awareness of social contextual resources, self-knowledge, motivation appraisal, and self-regulation. The WMI also improved targeted outcomes including physical activity behaviors and decreased fall risk. Injurious fall rates in the United States among older adults are continuing to rise (CDC, 2011a). Interventions that combine theory-based strategies addressing motivation for the initiation and maintenance of physical activity behaviors with proven

multicomponent balance and strength activities can contribute meaningfully to stemming the personal and financial costs of falls.

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APPENDIX A

STUDY DETAILS

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness			Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
			Behavioural Outcome (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*			
Alpert et al. (2009)	Pre-Post Jazz Dance, A,C,D	N = 68 Age 68	Objective PA: NA Subjective PA: NA	Fall risk; improved sensory organization tests for balance (p<.05)	NS differences in depression or cognition	Group activity	15 weeks Attendance 100% Attrition 13%	NA 1 week
Ashburn et al. (2007)	RCT IV, VI, I, A, D	Fall risk N = 142 Female 39% Age 71.6-72.7	Objective PA: NA Subjective PA: NA	Fall risk: functional reach improved (p = .009); other risk measures NS; significant interaction between falls/ injury and self-assessed disability (p = .021)	QOL improved in intervention group compared to control group (p = .033)	Individually delivered in home by PT	6 weeks Attendance: 95% Attrition 8%	NA 6 months
Barnett et al. (2003)	RCT IV,I,A,B,C,D	Fall risk N = 163 Female 70% Age 74.4	Objective PA: NA Subjective PA: NS differences	Fall risk: improved alternate step/coordination; NS differences in strength, reaction time, walking Falls: RR = .6 [95% CI.36-.99]	NS differences in SF-36, FOF	Group activities delivered in community by exercise instructor	52 weeks Median attendance 62% Attrition 8%	13% exercised daily at home NA
Binder et al. (2002)	RCT II, VII, A,B,C,D	N = 115 Female 52% Age 83	Objective PA: NA Subjective PA: NA	Fall risk: improved physical performance score, Vo2 peak, knee extension, knee flexion single leg stance time (p $\leq$ .05); BBS (p = .06)	Improved self-perceived functional status (p = .01)	Group activity delivered in exercise facility by PT tech	36 weeks Attendance 100% Attrition 23%	NA NA
Bunout et al. (2005)	RCT D,B	N = 298 Female 71% Age 75	Objective PA: NA Subjective PA: NA	Fall risk; improved gait speed, quad/bicep strength in women (p < 0.01); adherent females with increased walking capacity Falls: NS group differences		Group activity	52 weeks Mean attendance 52% Attrition 19%	NA 12 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Campbell et al. (2005)	RCT III, VI, VII, A,B,,D	Fall risk N = 391 Female 63-74 Age 83.6	Objective PA: NA Subjective PA: NA	Falls: IRR 1.5 (95% CI, 0.82 to 1.61); > 3 sessions per week with IRR .23 (95% CI, .12 to .45)		Individually delivered at home by PT	26 weeks Attendance NA Attrition 21%	19%>3x/wk, 36% 2-3x/wk 44% walked >2x/ wk 12 months
Carter et al. (2002)	RCT A,C,D	Osteoporosis N = 93 Female 100% Age 69	Objective PA: NA Subjective PA: NA	Fall risk improved: knee extension (p = .047); dynamic balance (p = .044); NS difference in static balance	NS differences in QOL	Group activities delivered in community centres by instructors	20 weeks Attendance 89% Attrition 14%	NA NA
Clemson et al. (2004)	RCT I,II, V, VII, A,D	Fall risk N = 310 Female 74% Age 78	Objective PA: NA Subjective PA Increased (p = .06).	Falls: RR for falling = .69 [95% CI,.50 to .96]	Improved protective behaviour, confidence ($p \leq 0.04$) NS differences in SE, health, worries	Group delivered in community by OT	7 weeks Attendance NA Attrition 9%	59% continued exercise 12 months
Day et al. (2002)	RCT VII, A,C,D	N = 272 Female 60% Age 76	Objective PA: NA Subjective PA: NA	Fall risk; improved strength, coordination, balance range (p < .001) Falls: RR .82 [95% CI, .70 to .97]		Group activity	15 weeks 80% attended > 50% Attrition 11%	Mean home exercises 9/ month 18 months
DiBrezzo et al. (2005)	Pre-post II, IV, A,C,D	N=16 Female 68% Age 75	Objective PA: NA Subjective PA: NA	Fall risk: improved chair stand (p = .005); arm curl (p = .03); back scratch (p =.008); 8 foot up and go (p < .001)	Instructors observed participants enjoying social interaction and encouragement	Group delivered in senior centres by instructors	10 weeks Attendance 77% Attrition 16%	NA NA

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Dubbert et al. (2002)	RCT III, VI, IV, I, B	N = 212 Female 1% Age 69	Objective PA: Accelerometer Subjective PA: Improved walking & PA ($p < .05$)	Fall risk: improved in all groups: 6 minute walk, balance, body girths, and weight ($p = .0001$)	Increased motivation ($p = .002$); increased walking when companion ($p = .02$); NS changes in SF 36	Individually delivered in clinic and phone by RN	8 weeks Attendance NA Attrition 15%	42% walking > 20 min 3 days/wk 12 months
Fukukawa et al. (2008)	Pre-Post II,I,VII,B,C,D	N = 29 Female 88% Age 74	Objective PA: NA Subjective PA: NA	Fall risk: NS changes in one-leg balancing time, walking speed	Improved falls SE ($p = 0.01$)	Group activity delivered in community centre	8 weeks Adherence: NA Attrition 11%	NA 3 months
Greaney et al. (2008)	Community-based RCT V, I, VI, VII, B,D	N = 966 Female 71% Age 75	Objective PA: NA Subjective PA: NS differences	Fall risk: NS group differences in Timed Up and Go (TUG)	Increased stage change when "maintenance' removed ($p = .04$). NS difference in SE	Individually delivered over the phone by counsellors	52 weeks Attendance: NA Attrition 20%	NA 12 months
Haines et al. (2009)	RCT I, VI, VII, A,D	Fall risk N=53 Female 66% Age 81	Objective PA: NA Subjective PA: Decreased ADL (all groups)	Falls: Both groups of participants with increased falls	Decreased health related QOL (all groups) NS changes in FOF	Individually delivered via DVD/ in person at home by PT	2 weeks Attendance: NA Attrition 34%	42% exercised 1x/wk(8wk) 6 months
Hakim et al. (2003)	Non-RCT II,VII, V, VI, I,E	N=80 Female 87% Age 73	Objective PA: NA Subjective PA: NA	Fall risk; NS group differences in BBS, TUG, or 30 second chair stand	Improved knowledge (F 5.81; $p < .05$) & fall efficacy ($p < .001$)	Group activity delivered in community centre	12 weeks Attendance NA Attrition 34%	24.5% 3 months
Hauer et al. (2001)	RCT A,D	Fall risk N=57 Female 100% Age 82	Objective PA: NA Subjective PA: NS differences at	Fall risk: improved walking velocity, balance, POMA ($p < .05$). NS differences in gait speed, TUG		Group activity delivered in rehabilitation by recreation specialist	12 weeks Attendance 85% Attrition 21%	NA 24 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
			6 months	Falls: relative risk 0.753 [.455-1.245]				
Healy et al. (2008)	Community based pre-post study V,I, III, II, A, D	N=335 Female 90% Age 79	Objective PA: NA Subjective PA: NS change at 12 months	Decreased fall rates at 6mo (p = .001) and 12 months (p = <.0001)	Improved falls efficacy (p = .013), management (p < .0001), control (p = .0218); social activity (p = .0516)	Group activity delivered in community by lay health volunteers	8 weeks Attendance: 89% Attrition: 25%	NA 12 months
Helbostad et al. (2004)	RCT IV, VII, III, I, A,C, D	Fall risk N=77 Female 80% Age 81	Objective PA: NA Subjective PA: NA	Fall risk:; improved gait speed, quad strength (p ≤ .02)); NS differences in functional tests, postural sway Falls: NS group differences		Group and individually delivered by PT	12 weeks Attendance; > 80% Attrition: 31%	NA 6 months
Inokuchi et al. (2007)	Multi-center controlled trial II, VII, I, C, D, A	Fall risk N=268 Female 84% Age 80	Objective PA: NA Subjective PA: NA	Fall risk: improved functional reach (p = 0.023), chair stand (p = .028), TUG (p = .003) NS differences, 5 meter walk, leg stand, hand grasp	NS differences in falls efficacy Improved depression (p = .000)	Group activity delivered in day centres by RN	17 weeks Mean attendance 91% Attrition 11%	NA NA
Iwamoto et al. (2009)	RCT VII, A,B,C,D	N=68 Female 89% Age 76.4	Objective PA: NA Subjective PA: NA	Fall risk: improved 1 leg stand, tandem gait, tandem standing (p < .001), chair rise, TUG, step length, 10n walking time (p < .05) Falls: Improved (p = .0363		Group activity delivered in clinic or hospital	20 weeks, thrice weekly meetings (30 minutes) Attendance 100% Attrition 1%	NA NA

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Kita et al. (2007)	Prospective community-based cohort study I, VII, A, D	Fall risk N= 683 Female 78% Age 77	Objective PA: NA Subjective PA: NA	Fall risk: Improved 1 leg stand (p = .001) Falls: decreased rates by 44% (p = .001); fractures by 47% (p = .05)		Individually delivered in clinic by orthopaedists	32 weeks Attendance NA Attrition 19%	23% daily; 31% 3-4/wk; 25% 1-2/ wk; 12 months
Laforest et al. (2009)	Quasi-experimental I, III, IV, V, VI, A, D	N= 200 Female 89% Age 74	Objective PA: NA Subjective improved PA variety (p = .001)			Group activity delivered in community by exercise instructor	12 weeks Mean attendance 78% Attrition 8%	NA 9 months
Latham et al. (2003)	Multicenter RCT IV, VI, D	Fall risk N= 486 Female= 66% Age= 80	Objective PA: NA Subjective PA: NA	Fall risk; NS group differences Falls: RR .96 [95% CI .67-1.36]	NS differences in SF36; ADL; falls SE; activities profile	Individually delivered in homes & phone by PT	10 weeks Mean attendance 82% Attrition 9%	NA 6 months
Li et al. (2005)	RCT E with music	N=256 Female 70% Age 77	Objective PA: NA Subjective PA: NA	Fall risk: improved BBS, gait, functional reach, 1 leg stand, walking , TUG (p < .001) Falls: RR .45 [95% CI .3 - .7]	Improved FOF (p < .001)	Group activity delivered by experienced Tai Chi instructor	2 weeks Median attendance : 78% Attrition 32.5%	NA 6 months
Lin et al. (2006)	Rural community-based I, E	N = 1200 Female 68% Age 75	Objective PA: NA Subjective PA: NA	Fall risk: improved Tinetti balance (p = .04) All groups with decreased fall rates 31%- 50%	NS changes in FOF, all groups	Group activity delivered in community by Tai Chi experts	52 weeks Mean attendance 49% Attrition 24.5%	NA 12 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Lin et al. (2007)	RCT I, II, A, C, D	Fall risk N = 150 Female 51% Age 76.8	Objective PA: NA Subjective PA: NA	Fall risk: (difference and 95% CI); improved functional reach; 1.5 cm [0.3 – 2.6] balance 1.3 [0.2 – 2.4], gait 0.4 [.1 - .8] Falls: NS differences in falls	Improved ADL; 0.9 [95% CI = .2 - 1.7]; depression;.5 [95% CI, .1 – 1]; FOF;-.8 [95% CI = -1.5 - -.2]	Individually delivered in home by PT	16 weeks Attendance: NA Attrition 16%	NA 4 months
Liu-Ambrose et al. (2004)	Community-based prospective study. A, C, D	N= 104 Female 100% Age 79	Objective PA: NA Subjective PA: improved in agility group (p =.03)	Fall risk: improved postural sway (p = 0.05) fall risk scores in strengthening group and agility group p <. 05); NS differences in quad strength, hand reaction, proprioception, edge contrast, dorsiflexion, foot reaction time		Group activity delivered by instructors	25 weeks Mean attendance 78-85% Attrition 6%	NA 12 months
Logghe et al. (2009)	RCT I, E	Fall risk N=269 Female 71% Age 77	Objective PA: NA Subjective PA: NS changes	Fall risk: NS changes in BBS Falls: NS change in fall rate: RR 1.16 [95% CI .84-1.6]	NS changes in fall efficacy	Group activity delivered by Tai Chi Chuan instructors	13 weeks Attendance: 47% ≥ 80% Attrition 11%	NA 12 months
Lord et al. (2003)	RCT II, IV, A, B, C, D	N=551 Female 87.6% Age 80	Objective PA: NA Subjective PA: NA	Fall risk: improved choice step reaction (p < .01), 6 minute walking distance (p < .05) Falls: RR .78 [95% CI, .62 .99]: those with previous falls: 0.69 [95% CI,.048-0.99]		Group activity delivered in community by trained instructors	52 weeks Mean attendance 42.3% Attrition 9%	NA 9 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Luukinen et al. (2007)	Community-based RCT IV, A, B, D	N=486 Female 81% Age 88	Objective PA: NA Subjective PA: NA	Fall risk: improved balance $p < .05$ Falls: NS group differences		Individually & group delivered (home & rehab) by PT / OT	One home visit Attendance: NA Attrition 13%	NA NA
Means et al. (2005)	RCT I, A, B, C, D	N=210 Female 57% Age 74	Objective PA: NA Subjective PA: NA	Fall risk: improved functional obstacle course: quality and time ($p = .001$) Falls: RR .40 [95% CI .25-.64]		Group activity delivered by PT	6 weeks Attendance NA Attrition 30%	NA 6 months
Morgan et al. (2004)	RCT IV, A, D	Fall risk N = 219 Female 70% Age 80-81	Objective PA: NA Subjective PA: NA	Fall risk: interactions; low baseline physical function, fewer falls ($p = \leq .03$, HR .51); high physical function, increased falls ($p = \leq .02$; HR, 3.51) Falls: NS group differences		Group activity delivered by PT and assistant	8 weeks Mean attendance 70% Attrition 31.4%	NA 8 months
Nitz & Choy (2004)	RCT I, VI, II, A, D	N = 73 Female 76% Age 76	Objective PA: NA Subjective PA: NA	Fall risk; NS group differences Falls: Both groups had significant falls reduction ($p = .000$).		Group activity delivered in clinic setting by PT and student	10 weeks Attendance; NA Attrition 39%	NA 3 months
Robertson et al. (2001)	RCT Pre-Post III, IV, A, B, D	N = 240 Female 67.5% Age 81	Objective PA: NA Subjective PA: NA	Fall RR: .54 [95% CI, .32 - .90] Injurious fall RR 4.6 [95% CI,1- 21]	Programme $432 per person per year; $576 and $1,563 saved per fall / injurious fall prevented	Individually Delivered in homes by RN	24 weeks Attendance NA Attrition 12%	72%, > 2 x/ wk; 12 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Robitaille et al. (2005)	Community based quasi-experimental VII, I, A, D	N = 200 Female 84% Age 74	Objective PA: NA Subjective PA: NA	Fall risk: improved static balance and mobility measures ($p < 0.01$); NS differences functional reach, L or R lateral reach, sit to stand		Group activity delivered in community by fitness pro	12 weeks Mean attendance78 % Attrition 18%	NA 3 months
Rubenstein et al. (2000)	RCT IV, A, B, D	N = 59 Male 100% Age 76	Objective PA: NA Subjective PA: Improved ($p = 0.03$)	Fall risk: improved walking, gait, right knee flexion and extension ($p < .05$) NS changes in other functional and isometric exercises Falls: rate improved among those with increased PA ($p = .05$)	Improved global health (SF 36) $p = .005$	Group activity delivered in clinic by exercise PT students	12 weeks Mean attendance: 84% Attrition 12%	NA NA
Sherrington et al. (2008a)	RCT VII, VI, A, B, D	N=173 Female 50% Age 74.9	Objective PA: NA Subjective PA: NA	Fall risk: improved balance ($p = 0.005$); stepping ($p = .005$); sit to stand ($p = .037$); gait ($p = .005$) and 6 minute walk ($p = .005$); NS group difference in strength		Group activity delivered in outpatient rehabilitation by PT	5 weeks Attendance: NA Attrition 8%	NA NA
Shigematsu et al. (2008)	RCT Square stepping, V, C, B, D	N = 68 Female 56% Age 69	Objective PA: pedometer higher in walking group ($p < .001$) Subjective PA: NA	Fall risk: improved leg extension, forward/ backward tandem walking, stepping, walking around cones, reaction time ($P < .05$) Falls: NS group differences	Improved perceived health status ($p = .002$) NS change in FOF or pleasure during exercise	Group activity in delivered health centre by exercise instructors	12 weeks Attendance: 84% - 91% Attrition 5%	NA 3 months

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Skelton et al. (2005)	RCT VII, A, B, D	Fall risk N =100 Female 100% Age 73	Objective PA: NA Subjective PA: NA	Falls: RR: 69 [95% CI,.5-.9]; total falls: 243 (39.5% at home); 2.7% causing hip fracture		Group activity delivered by exercise instructors	36 weeks Attendance NA Attrition 30%	NA 3 months
Steadman et al. (2003)	RCT (single blind) I, A, B, D	Fall risk N = 198 Female 80% Age 82	Objective PA: NA Subjective PA: NA	Fall risk: NS group differences: both groups improved BBS, 10m timed walk Falls: NS group differences in number of falls (both decreased)	Increased confidence (p=.02). NS group difference in QOL (both increased)	Group activity delivered in hospital setting by PT	6 weeks, twice weekly meetings (45 minutes) Attendance NA Attrition 33%	NA 6 months
Suzuki et al. (2004)	RCT VI, VII, A, B, C, D	N = 52 Female 100% Age 77	Objective PA: NA Subjective PA: NA	Fall risk: improved tandem walk, functional reach, knee strength (p = .029) Falls: 13.6% (intervention) vs. 54.5% (control) (p = .0097)		Group activity delivered in community centres	26 weeks Mean attendance 75.3% Attrition 15%	NA 20 months
Vogler et al. (2009)	RCT II, VII, A, D	Fall risk N = 180 Female 79% Age 80.7	Objective PA: NA Subjective PA: NA	Fall risk: exercise groups improved physiological profile scores (p <.05); weight bearing group improved coordinated stability, maximal balance range, body sway (p<.05) Falls: NS group differences	NS group differences in falls self-efficacy, depression, ADL	Individually delivered in home by PT	12 weeks Mean attendance 70% Attrition 6%	NA NA

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	*Health outcomes (falls)*	*Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Voukela-tos et al. (2007)	Community based RCT E	N =702 Female 84% Age 69	Objective PA: NA Subjective PA: NA	Fall risk: improved sway, lateral stability, coordinated stability reaction time ($p < .05$); NS difference in lateral stability Falls: RR .67 [95% CI,.47 to .94]		Group activity delivered in community by Tai Chi instructors	16 weeks Mean attendance: 71% Attrition 3%	NA 2 months
Weer-desteyn et al. (2006)	RCT I, A, B, D	Fall risk N = 113 Female 75% Age 74	Objective PA: NA Subjective PA: NA	Fall risk: NS group differences; both improved one leg stand, number of weight shifts. Falls: IRR .54 [95% CI,.34 .86]	Improved balance confidence ($p = .001$)	Group activity	5 weeks Mean attendance 87% Attrition 11%	NA 7 months
Weer-desteyn et al. (2009)	Community based pre post study I, A, B, D	Fall risk N = 88 Age 73.8	Objective PA: NA Subjective PA: NA	Fall risk: BBS, Functional reach, Timed one-leg stance, Timed tandem stance, Step test, maximum step length, comfortable gait speed) improved significantly ($p < .01$) Falls: RR .68 [95% CI, .50-.91]	FOF decreased ($p < .0001$)	Group activity delivered in rehabilitation facility by PT	5 weeks Attendance: NA Attrition: NA	NA 12 months
Woo et al. (2007)	RCT D, E	N= 180 Female 50% Age 68	Objective PA: NA Subjective PA: NA	Fall risk: NS group differences in gait velocity, stance time, balance (SMART meter) or bend reach. Falls: NS decline in both exercise groups compared to control		Group activity delivered in community centres	52 weeks Mean attendance 76.3% (exercise), 81% (Tai chi) Attrition 2%	NA NA

Study Details

Author	Study Design *Critical Content*	Reach *Population*	Efficacy/Effectiveness *Behavioural Outcome* (Physical Activity)	Efficacy/Effectiveness *Health outcomes (falls)*	Efficacy/Effectiveness *Psychosocial outcomes*	Adoption	Implementation *Delivery Attendance Attrition*	Maintenance *Behaviour Follow-up*
Critical Content (behavioural, affective, cognitive elements): I education about falls and safety; II encourage social interaction; III enhance motivation for physical activity; IV individualize or tailor physical activities; V promote reduction of fear or optimize efficacy (fall or self); VI promote self-regulation; VII provide resources for physical activities at home. Critical Content (physical activity elements): A balance; B endurance; C flexibility; D leg strengthening; E Tai Chi. *Abbreviations:* ADL activities of daily living; BBS Berg Balance Scale; FOF fear of falling; HR hazards ratio; NA not available or not described; NS non-significant; PA physical activity; PT physical therapist or physiotherapist; quad quadriceps; QOL quality of life; RN registered nurse, RR rate ratio; SE self-efficacy; TUG timed up and go; wks weeks.							

APPENDIX B

CONSENT FORM

CONSENT FORM TO PARTICIPATE IN A RESEARCH PROJECT ENHANCING MOTIVATION FOR ACTIVITY TO REDUCE THE RISK OF FALLS

Essentia Principal Investigator: Siobhan McMahon MSN, MPH, GNP-BC

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 & Health Innovation, Jean F. Wyman, PhD, RN, GNP-BC, FAAN, FGSA, University of Minnesota, College of Nursing, and Siobhan McMahon MSN, MPH, GNP-BC, Doctoral student, Arizona State University, College of Nursing and Health Innovation.

STUDY PURPOSE

The purpose of this study is to evaluate the benefits of an intervention designed to enhance motivation for activities that reduce fall risk. To evaluate this intervention two groups will be compared. The first group will participate in an 8 week program that is designed to enhance motivation for physical activities that reduce fall risk. The second group will participate in an 8 week program that is designed to promote safety and wellness.

DESCRIPTION OF RESEARCH STUDY

If you decide to participate in this study, you will need to take part in an initial meeting with study staff. At that first meeting, we will make sure you are eligible to participate in the study by asking you questions about:

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

We will also ask for the name of your health care provider so that we can notify them of your interest in this study and ask for their approval. Our communication with your healthcare provider will be via electronic mail.

If you qualify for the study and are interested in participating, you can choose to sign this informed consent form. Data will be collected at two time points. The first data collection time will be immediately after you sign the consent form. The second data collection time will be after eight weeks. Each data collection time will take approximately 45 to 60 minutes to complete. During the first data collection time 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 45-60 minute data collection times we will also ask you about:

- Your fall risk
- Your level of support from family and friends
- Your feelings about being physically active
- Your assessment of neighborhood safety
- Activities you typically participate in

During each of the two 45-60 minute data collection times we will also:

- Measure your balance and strength by watching you walk, sit, and stand
- Ask you to wear a light-weight device (similar to a cell phone), during waking hours for seven days. This will measure your activity patterns.

Each individual data collection time will be arranged at your convenience.

After the first data collection interview and session is complete, you will be assigned by lottery (chance) to be in the motivation for physical activity group or the safety and wellness group. This means that neither you nor the study staff will know ahead of time which group you will be in. After you are assigned to a group, the 8 weeks of the study will begin.

Motivation for Physical Activity Group: The motivation for physical activity group will meet at a community center in Itasca County once every week for a total of 8 weeks. During these meetings we will discuss fall risk, safety, and physical activity. Group discussions will help you to find ways to work leg strengthening, balance, and walking activities into your daily routines. Using a sturdy chair or table for balance and support, we will guide you to practice strengthening and balance exercises. The exercise program we will follow has been designed and tested by an expert in exercise physiology for use in older adult populations. The exercise intensity will be adjusted to your preferences, current strength, and

abilities. Over the course of the eight meetings, exercises will be introduced gradually to allow you time to learn them and to build your strength and abilities. Exercises will be practiced for a few minutes during the first study meeting. Over time, the amount of time spent exercising during the study meetings will slowly increase to last approximately 30 minutes. The goal will be to repeat each physical movement 8-10 times (fewer if you are fatigued). Each week you will choose 2-4 of the exercises practiced in study meetings to also practice at home. Following is a list of exercises and movements that will be practiced in a chair, or using a chair for balance, during our study meetings:

- **Weeks 1-2**: Gentle ankle, head, neck, trunk, back, and ankle movements; walking; and movements that strengthen your ankle and leg muscles.
- **Weeks 3-6**: Those movements described in weeks 1-2 and movements that strengthen your hip muscles.
- **Weeks 7-8**: Those movements described in weeks 1-2 and movements that strengthen your hip muscles.

We will also discuss ways that you can safely do these exercises at home and how you might develop walking routines at home. During each meeting we will have time for discussion, sharing experiences, and questions. These study meetings will be randomly audio-taped to verify that the content delivery is consistent. You also will record your daily activities in an activity calendar that we will give you.

Safety and Wellness group: The safety and wellness group will meet at a community center in Itasca County once every week for a total of 8 weeks. During those meetings we will provide information and instruction that will help you stay safe and optimize wellness. Topics include information about decreasing fall risk, vision and hearing, medication safety, pain, nutrition and supplements, environmental safety, and foot care. During each meeting we will have time for discussion, sharing experiences, and questions. These meetings will be randomly audio-taped to verify that the content delivery is consistent.

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 stiffness, when you start the physical activity program. This is expected and typically improves with continued activity. There is a slight risk that you may 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. Ms. Siobhan McMahon will be available for consultation, should the need arise at (218) 290-3422.

BENEFITS
The possible benefits of your participation in the study may include improvement of your knowledge on health, wellness, and general safety issues for 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 the researchers will not identify you. In order to maintain confidentiality of your records, a number will be assigned to your name and will retain any information about you. All information will be stored in locked files.

COSTS AND PAYMENTS
The researchers want your decision about participating in the study to be absolutely voluntary. Yet they recognize your participation may pose some inconvenience for you. In order to express appreciation for the time and effort you provide to be in the study, we will provide a $10.00 gift card for each data collection session. You will receive it on the same day that you complete the data collection. There are 2 data collection times in the study. You will receive up to $20.00 in gift cards for being in the study, whether you are in the motivation for physical activity group or the safety and wellness group.

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. Siobhan McMahon at (218) 786-8891. For information on research patients' rights please contact Ms. Faye Witt, Legal Counsel for Essentia Health and a member of Essentia Health's Institutional Review Board, at (218) 786-8364. This form explains the nature, demands, benefits and any risk 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 given to you.

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

_____ _____ _____
Subject's Signature Printed Name Date

_____ _____
Legal Authorized Representative Printed Name Date
(if applicable)

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 (offered) the subject/participant a copy of this signed consent document."

Signature of Investigator_____

Date_____

APPENDIX C

DATA COLLECTION PACKET

BASELINE MEASURES (Time 1)

Ready~Steady

DATA COLLECTION PACKET

Participant ID _____ (ID)
Date _____ (DOVT1)
Data Collector _____ (DCInititalsT1)

Thank-you again for participating in the ***Ready~Steady*** research program! You remember that the purpose of the ***Ready~ Steady*** 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.

- We will first start with a set of questions about you, support you have for being active and your health goals and then take a short break.
- Next we will ask specific questions about your activity.
- We will then observe you move (for example, standing, walking and sitting).
- Finally, we will give you your i-touch 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.*

PARTICIPANT ID_____ ; DATE: _____

For Data Entry Only: Participant Tracking

Entered in SPSS 1. Date_____(DEDate_T!a)_ Initials _____(DEInitials_T1a)

2. Date_____(DEDate_T!b)_ Initials _____(DEInitials_T1b)____

	Date	Initials	Date	Initials

For Data Entry Only - SPSS

	Date	Initials
Data Verified	_____(DV_T1)	_____(DVI_T1
Data Modified	_____(DM_T1)	_____(DMI_T1)

PARTICIPANT ID_____ ; DATE: _____

College of Nursing & Healthcare Innovation
ARIZONA STATE UNIVERSITY
Dream • Discover • Deliver

Writing with grey highlighting is for administrative purposes

PART I
DEMOGRAPHIC DATA
Circle your answer or
Write in the blank as directed

The first set of questions ask details about you, your age etc. These questions are similar to questions the census bureau asks you. In this project we will not attach your name or any form of personal identification, other than your study number, to the information and opinions 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 /year: __/___/_____ (DOB)

2. What is your race: (RACE)
    1. White
    2. Black or African American
    3. American Indian or Alaska Native
    4. Name of enrolled or principal tribe_____ (TRIBE)
    5. Asian Indian
    6. Chinese
    7. Filipino
    8. Japanese
    9. Korean
    10. Vietnamese

11. Other Asian (Print race for example, Hmong, Cambodian, Laotian, Pakistani)_____ (OTHERA)
12. Native Hawaiian
13. Guamanian or Chamorro
14. Samoan
15. Other Pacific Islander (Print race, for example, Fijian, Tongan, and so on)_____ (OTHERPI)
16. Some other race (print)_____

3. What is your total household monthly income (including Social Security)? (INCOME)

1. $100 to $499
2. $500 to $999
3. $1,000 to $1,499
4. $1,500 to $1,999
5. $2,000 or more

4. What is the total number of people who live in your house?_____ (HOUSEHOLD)

5. How many years of school have you completed: _____years (EDUCATION)

6. Tell me about your employment, Are you (EMPLOY)

1. Retired
2. Employed part time
3. Employed full time
4. Unemployed
5. Not employed
6. A Volunteer

PARTICIPANT ID_____ ; DATE: _____

7. What is your sex? _____Female _____Male (SEX)

The next four questions ask about factors that are associated with fall risk. There is no right or wrong answer.

FALL RISK

How many falls have you had in the last year?

_____ Risk_Falls

Do you use a cane, walker or wheelchair?

Yes_____ No_____ Risk_AD

Do you have difficulty walking?

Yes_____ No_____ Risk_walk

Do you have problems with your balance?

Yes_____ No_____ Risk_balance

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Community Resources

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

Referring to this scale: please **assign 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***	***Does not apply***
1	**2**	**3**	**4**	**5**	**888**

QUESTION	LABEL	RESPONSE
1. During the past 6 months how often have you walked or strolled in your neighborhood?	NWAT1_1	
2. During the past 6 months how often have you walked or done any other physical activity with your neighbors?	NWAT1_2	
3. During the past 6 months how often have you gone to a neighborhood park for walks or other physical activities?	NWAT1_3	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Community Resources (continued)

Let's talk a bit about the places where you are active and the resources available for being active.

Referring to this scale **please write 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***	***Does Not Apply***
1	**2**	**3**	**4**	**5**	**888**

STATEMENT	LABEL	RESPONSE
There are no hills in my neighborhood.	NEQT1_1	
My neighborhood streets are well lit at night.	NEQT1_2	
There are no unattended dogs in my neighborhood.	NEQT1_3	
There are many attractive natural sights in my neighborhood.	NEQT1_4	
Many people walk and participate in physical activities frequently (3-5 times per week) in my neighborhood.	NEQT1_5	
My neighborhood is safe from crime.	NEQT1_6	
My neighborhood gets its fair share of public money to spend on recreation areas and facilities.	NEQT1_7	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Community Resources (continued)

8. *How would you describe your neighborhood (circle your answer)* ***?*** NEQT1_8

1. rural country
2. residential
3. mixed resident/commercial
4. mainly commercial

9. *If you are active outside your home or neighborhood, what is the distance in miles from your home to the place where you perform most of your physical activity (e.g. walking or strength/ balance activities)?* _____ miles. (If you do these physical activities in your home or in your neighborhood, write "0" in the blank) NEQT1_9

10. *List community organizational resources available to help you stay physically active through strengthening/ balance activities or walking:*

Resource(s)		Times used per **month**
NEQT1_10R1 1._____	NEQT1_10F1	_____
NEQT1_10R2 2._____	NEQT1_10F2	_____
NEQT1_10R3 3._____	NEQT1_10F3	_____
NEQT1_10R4 4._____	NEQT1_10F4	_____
NEQT1_10R5 5._____	NEQT1_10F5	_____

Code/ list of resources identified

1. *Hiking Trails*
2. *YMCA*
3. *Bone Builders*
4. *Community Center*
5. *Shopping Center or*
6. *Sidewalks*
7. *Church*

8. A certain store such as Target or Wal-Mart
9. _____
*10.*_____
*11.*_____

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Measure of Social Support: Social Support and Exercise Survey

This page focuses on your perceptions or opinions about the social support you have to be active. Here is a general list of things that family or friends might do or say to help you be active (e.g. walking or participating in strengthening / balance activities).

Using the numbers here (1-5) assign how often a family member or friend has said or done what is described in the statement. When thinking about statements concentrate in the last three months. For each statement, consider the actions and/or statements of family and then friends.

Not at all	***Rarely***	***A few times***	***Often***	***Very often***	***Does not apply***
1	**2**	**3**	**4**	**5**	**888**

PARTICIPANT ID_____ ; DATE: _____

STATEMENT	**LABEL**	RESPONSE **FAMILY**	**LABEL**	RESPONSE **FRIENDS**
Participated in strengthening / balance activities or walked with me.	SSFAM_T1_1		SSFR_T1_1	
Offered to participate in strengthening / balance activities or walk with me.	SSFAM_T1_2		SSFR_T1_2	
Gave me helpful reminders to do strengthening / balance activities or walk.	SSFAM_T1_3		SSFR_T1_3	
Gave me encouragement to participate in strengthening / balance activities or walk.	SSFAM_T1_4		SSFR_T1_4	
Changed their schedule so we could do strengthening / balance activities or walk together.	SSFAM_T1_5		SSFR_T1_5	
Discussed strengthening / balance activities or walking with me.	SSFAM_T1_6		SSFR_T1_6	
Complained about the time I spend doing strengthening / balance activities and walking.	SSFAM_T1_7		SSFR_T1_7	
Criticized me or made fun of me for doing strengthening/ balance activities and walking.	SSFAM_T1_8		SSFR_T1_8	
Gave me rewards for being active (bought me something or gave me something I like).	SSFAM_T1_9		SSFR_T1_9	
Planned for walking or engaging in strengthening/ balance activities on recreational outings.	SSFAM_T1_10		SSFR_T1_10	
Helped plan activities around my strengthening / balance activities or walking.	SSFAM_T1_11		SSFR_T1_11	

PARTICIPANT ID_____ ; DATE: _____

Asked me for ideas on how they can do more strengthening / balance activities or walking.	SSFAM_T1_12		SSFR_T1_12	
Talked about how much they like to stay active through strengthening / balance activities or walking.	SSFAM_T1_13		SSFR_T1_13	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Self-Knowledge Inventory

This next set of questions is about your thoughts about yourself and your health. Probably everyone thinks about his or her health to some extent. When doing so, we usually think about the kinds of experiences that are in store for us and what our health might be like. We would like for you to take a few minutes and think about yourself and your health.

1. List one health problem that bothers you the most, or that you think needs improving (SKI_TI_1):

   _____

2. What goals have you set to improve your health related to this problem (SKI_T1_2)?

   _____

   _____

   _____

3. What activities are you currently doing or thinking about to improve your health related to this problem (SK1_T2_3)?

   _____
   _____
   _____
   _____

PARTICIPANT ID_____ ; DATE: _____

Referring to this scale, please write the number (1-5) that corresponds to your response to the questions below**.**

Not at all	***Rarely***	***Maybe***	***Probably***	***Very Certain***	***Does not apply***
1	**2**	**3**	**4**	**5**	**888**

QUESTION	LABEL	RESPONSE
4. How able do you feel that you can perform your activities listed, on a regular basis?	SKI_T1_4	
5. How likely do you think it is that you will achieve your goals?	SKI_T1_5	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Goal Attainment Scale

This table guides each person to set their individual goals and their expected outcomes. We are asking you to set goals before the study starts. By goals, we mean statements about your wishes and plans related to health, activity, safety and medications that are specific and measurable. Additionally, we want you to think about how *you* will evaluate your own outcomes related to the goals you set. At the end of this research study, you will evaluate the progress you have made toward accomplishing your goals.

EXAMPLE

Before you write your own goals, read through this example of sample goals and expectations/ criteria for self-evaluation go on to write your own goals starting on page 12:

EXAMPLE: Goal Statement about Health	**Outcome Value**	**(-2,-1,0,+1,+2)**
No attempts at making appointment.	Least favorable outcome (-2)	
Phone number of doctor obtained but appointment not made.	Less than expected outcome (-1)	
(GAS_T1_G1). **Within 8 weeks I will schedule my annual appointment with the eye doctor.**	Expected outcome (0)	
Appointment made and necessary pre-visit tests obtained.	More than expected outcome (+1)	

PARTICIPANT ID_____ ; DATE: _____

EXAMPLE: Goal Statement about Health	**Outcome Value**	**(-2,-1,0,+1,+2)**
Appointment made and completed	Most favorable outcome (+2)	
I walked less than once per week.	Least favorable outcome (-2)	
I walked two times per week for one hour.	Less than expected outcome (-1)	
(GAS_T1_G2) **Within 8 weeks I will develop a routine of walking 3 times per week (1.5 hours each walk)**	Expected outcome (0)	
I walked five times per week (one hour each walk)	More than expected outcome (+1)	
I walked five times per week (more than one hour each walk)	Most favorable outcome (+2)	
EXAMPLE Goal Statement about Safety	**Outcome Value**	**Baseline Value** GAS_T1_O3) **(-2,-1,0,+1,+2)**
I did not add safety reflector or guardrail	Least favorable outcome (-2)	
I added safety rail but not the reflector.	Less than expected outcome (-1)	

PARTICIPANT ID_____ ; DATE: _____

GAS_T1_G2). **Within 8 weeks I will add safety strips and a handrail to the stairs leading to my basement.**	Expected outcome (0)	
I added safety reflector, handrail within one week, not eight.	More than expected outcome (+1)	
I added safety reflector, handrail and brighter light	Most favorable outcome (+2)	
EXAMPLE Goal Statement about Medication	**Outcome Value**	**(-2,-1,0,+1,+2)**
I did not have my medications reviewed by a professional	Least favorable outcome (-2)	
I made an appointment with my pharmacist to review my medications	Less than expected outcome (-1)	
GAS_T1_G4) **Within 8 weeks I will ask my health care provider or the pharmacist to review my medications .**	Expected outcome (0)	
I reviewed my medications with my pharmacist and my health care provider.	More than expected outcome (+1)	
I have a plan for reviewing my medications every 6 months with my pharmacist.	Most favorable outcome (+2)	

PARTICIPANT ID_____ ; DATE: _____

Goal Attainment Scale- Goal 1

Now write *your* goals. Think about goals that are relevant to your situation and preferences:

Start by writing your goal in the shaded box (what would the goal look like and when do you hope to achieve it). Then to help you evaluate your own goal accomplishments, think about what you might see if you exceed your goal and what you might see if your goal is not met.

Goal Statement about Health	**Outcome Value**	**Your Scores (-2,-1,0,+1,+2)**	
		Baseline GAS_T1_O1	**Follow-up** GAS_T2_O1
	Least favorable outcome (-2)		
	Less than expected outcome (-1)		
(GAS_T1_G1) GOAL ABOUT HEALTH:	Expected outcome (0)		
	More than expected outcome (+1)		
	Most favorable outcome (+2)		

PARTICIPANT ID_____ ; DATE: _____

Goal Attainment Scale- Goal 2

Goal Statement about Activity	**Outcome Value**	**Your Scores (-2,-1,0,+1,+2)**	
		Baseline GAS_T1_O2	**Follow-up** GAS_T2_O2
	Least favorable outcome (-2)		
	Less than expected outcome (-1)		
GAS_T1_G2): GOAL ABOUT ACTIVITY	Expected outcome (0)		
	More than expected outcome (+1)		
	Most favorable outcome (+2)		

PARTICIPANT ID_____ ; DATE: _____

Goal Attainment Scale- Goal 3

Goal Statement about Safety	**Outcome Value**	**Your Scores (-2,-1,0,+1,+2)**	
		Baseline GAS_T1_O3	**Follow-up** GAS_T2_O3
	Least favorable outcome (-2)		
	Less than expected outcome (-1)		
GAS_T1_G3): GOAL ABOUT SAFETY	Expected outcome (0)		
	More than expected outcome (+1)		
	Most favorable outcome (+2)		

PARTICIPANT ID_____ ; DATE: _____

Goal Attainment Scale- Goal 4

Goal Statement about Medication	**Outcome Value**	**Your Scores (-2,-1,0,+1,+2)**	
		Baseline GAS_T1_O4	**Follow-up** GAS_T2_O4
	Least favorable outcome (-2)		
	Less than expected outcome (-1)		
GAS_T1_G4): GOAL ABOUT MEDICATION	Expected outcome (0)		
	More than expected outcome (+1)		
	Most favorable outcome (+2)		

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Index of Readiness

This set of questions reflects how people feel about the ways they try to stay active through strengthening/ balance activities and walking. Please answer each statement by first thinking about the statement, then writing the number (1-5) which best describes the extent to which you agree with the statement.

Strongly Disagree	***Disagree***	***Somewhat Agree***	***Agree***	***Strongly Agree***	***Does Not Apply***
1	**2**	**3**	**4**	**5**	**888**

Questions	**LABEL**	**RESPONSE**
I think about what might happen if I don't begin a program of strengthening/ balance activities and walking.	IR_T1_Q1	
I don't participate in strengthening/ balance activities and walking as often as I feel that I could.	IR_T1_Q2	
I think that I need to change some of the things that keep me from participating in strengthening/ balance activities and walking.	IR_T1_Q3	
I have planned new ways to stay active through strengthening/ balance activities and walking.	IR_T1_Q4	
I have thought about ways I can make strengthening/ balance activities and walking fit into my life.	IR_T1_Q5	

PARTICIPANT ID_____ ; DATE: _____

I have a plan for how to overcome barriers to participating in strengthening/ balance activities and walking regularly.	IR_T1_Q6	
I am willing to make sacrifices in order to participate in strengthening/ balance activities and walking on a regular basis.	IR_T1_Q7	
I am determined to succeed in making strengthening/ balance activities and walking a part of my life.	IR_T1_Q8	
I am committed to making lasting changes in the ways that I stay active through strengthening/ balance activities and walking.	IR_T1_Q9	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

Index of Self-Regulation

The next group of questions contains statements that describe how people feel about how they stay active through strengthening/ balance activities and walking. Please answer each statement by first thinking about the statement, then writing the number which best describes the extent to which you agree or disagree with the statement.

Strongly Disagree	***Disagree***	***Somewhat Agree***	***Agree***	***Strongly Agree***	***Does Not Apply***
1	**2**	**3**	**4**	**5**	**888**

Questions	**LABEL**	**RESPONSE**
I think of the benefits of regularly practicing strengthening/ balance activities and walking.	ISR_T1_Q1	
I remind myself of the good that I am doing by participating in strengthening/ balance activities and walking. .	ISR_T1_Q2	
I remind myself of the importance of strengthening/ balance activities and walking.	ISR_T1_Q3	
I keep track of the ways that I stay active by participating in strengthening/ balance activities and walking.	ISR_T1_Q4	
I watch for signs of progress as I stay active by participating in strengthening/ balance activities and walking.	ISR_T1_Q5	
I monitor myself to see if I am meeting my goals for strengthening/ balance activities and walking.	ISR_T1_Q6	

PARTICIPANT ID_____ ; DATE: _____

I have learned new habits that help me to participate in strengthening/ balance activities and walking.	ISR_T1_Q7	
I have learned new ways to keep active through strengthening/ balance activities and walking.	ISR_T1_Q8	
I have learned to make changes in my strengthening/ balance activities and walking that I can live with.	ISR_T1_Q9	

Refused=666; Does not know: 777; Does not apply: 888; Missing; 999

PARTICIPANT ID_____ ; DATE: _____

You are doing great!!

Let's take a short break

PARTICIPANT ID_____ ; DATE: _____

Ready~Steady
DATA COLLECTION PACKET PART II

Baseline / Time 1

PART II: CHAMPS Activities Questionnaire for Older Adults

Contact: Anita L. Stewart, Ph.D., UCSF, anitast@itsa.ucsf.edu

PARTICIPANT ID_____ ; DATE: _____

This questionnaire is about activities that you may have done in the past 4 weeks. The questions on the following pages are similar to the example shown below.

INSTRUCTIONS

If you DID the activity in the past 4 weeks:

Step #1 Check the YES box.

Step #2 Think about <u>how many</u> TIMES <u>a week</u> you usually did it, and write your response in the space provided.

Step #3 Circle how many TOTAL HOURS <u>in a typical week</u> you did the activity.

Here is an example of how Mrs. Jones would answer question #1: Mrs. Jones usually visits her friends Maria and Olga <u>twice a week</u>. She usually spends <u>one</u> hour on Monday with Maria and <u>two</u> hours on Wednesday with Olga. Therefore, the total hours a week that she visits with friends is <u>3</u> hours a week.

In a typical week during the past 4 weeks, did you…	1	2	3	4	5	6

PARTICIPANT ID_____ ; DATE: _____

1. Visit with friends or family (other than those you live with)? ☒ **YES** How many TIMES a week?___2___ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

If you DID NOT do the activity:

- **Check the NO box and move to the next question**
- **Refused=666; Does not know: 777; Does not apply: 888; Missing; 999**

If you DID NOT do the activity:

- **Check the NO box and move to the next question**

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
1. Visit with friends or family (other than those you live with)? (CHAMPS_T1_Q1F) □ **YES** How many TIMES a week?_____ ➔ □ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q1HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
2.Go to the senior center? (CHAMPS_T1_Q2F) □ **YES** How many TIMES a week?_____ ➔ □ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ CHAMPS_T1_Q2HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
3. Do volunteer work? (CHAMPS_T1_Q3F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ CHAMPS_T1_Q3HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
4. Attend church or take part in church activities? (CHAMPS_T1_Q4F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ CHAMPS_T1_Q4HR	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
5. Attend other club or group meetings? (CHAMPS_T1_Q5F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q5HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
6. Use a computer? (CHAMPS_T1_Q6F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q6HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
7. Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)? (CHAMPS_T1_Q7F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q7HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
8. Do woodworking, needlework, drawing, or other arts or crafts? (CHAMPS_T1_Q8F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q8HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
9. Play golf, carrying or pulling your equipment (count walking time only)? (CHAMPS_T1_Q9F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q9HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
10. Play golf, riding a cart (count walking time only)? (CHAMPS_T1_Q10F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q10HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
11. Attend a concert, movie, lecture, or sport event? (CHAMPS_T1_Q11F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q11HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
12. Play cards, bingo, or board games with other people? (CHAMPS_T1_Q12F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q12HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
13. Shoot pool or billiards? (CHAMPS_T1_Q13F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q13HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
14. Play singles tennis (do not count doubles)? (CHAMPS_T1_Q14F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q14HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
15. Play doubles tennis (do not count singles)? (CHAMPS_T1_Q15F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q15HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
16. Skate (ice, roller, in-line)? (CHAMPS_T1_Q16F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q16HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
17. Play a musical instrument? (CHAMPS_T1_Q17F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q17HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
18. Read? (CHAMPS_T1_Q18F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q18H)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
19. Do heavy work around the house (such as washing windows, cleaning gutters)? (CHAMPS_T1_Q19F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q19H)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
20. Do light work around the house (such as sweeping or vacuuming)? (CHAMPS_T1_Q20F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q20H)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
21. Do heavy gardening (such as spading, raking)? (CHAMPS_T1_Q21F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q21H)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
22. Do light gardening (such as watering plants)? (CHAMPS_T1_Q22F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q22HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
23. Watch TV? (CHAMPS_T1_Q23F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q23HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
24. Talk on the phone? (CHAMPS_T1_Q24F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q24HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
25. Work on your car, truck, lawn mower, or other machinery? (CHAMPS_T1_Q25F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q25HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
26. Sit and talk with friends (not on phone) or listen to music? (CHAMPS_T1_Q26F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q26HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
****Please note: For the following questions about running and walking, include use of a treadmill.**							
27. Jog or run? (CHAMPS_T1_Q27F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q27HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
28. Walk uphill or hike uphill (count only uphill part)? (CHAMPS_T1_Q28F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q28HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
29. Walk fast or briskly for exercise (do not count walking leisurely or uphill)? (CHAMPS_T1_Q29F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q29HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
30. Walk to do errands (such as to/from a store or to take children to school (count walk time only)? (CHAMPS_T1_Q30F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q30HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
31. Walk leisurely for exercise or pleasure? (CHAMPS_T1_Q31F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q31HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
32. Drive in a car? (CHAMPS_T1_Q32F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q32HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
33. Ride a bicycle or stationary cycle? (CHAMPS_T1_Q33F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q33HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
34. Ride in a car being driven by someone else? (CHAMPS_T1_Q34F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q34HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
35. Do other aerobic machines involving arms and legs such as rowing, or step machines (do not count treadmill or stationary cycle)? (CHAMPS_T1_Q35F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q35HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
36. Travel by bus on a regularly scheduled service? (CHAMPS_T1_Q36F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q36HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
37. Do water exercises (do not count other swimming)? (CHAMPS_T1_Q37F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q37HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
38. Swim moderately or fast? (CHAMPS_T1_Q38F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q38HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
39. Use a "dial-a-ride" service or other transport service? (CHAMPS_T1_Q39F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q39HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
40. Swim gently? (CHAMPS_T1_Q40F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q40HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
41. Do stretching or flexibility exercises (do not count yoga or Tai-chi)? (CHAMPS_T1_Q41F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q41HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
42. Do yoga or Tai-chi? (CHAMPS_T1_Q42F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q42HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
43. Bicycle to do errands (count bicycling time) ? (CHAMPS_T1_Q43F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q43HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
44. Do aerobics or aerobic dancing? (CHAMPS_T1_Q44F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q44HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
45. Walk your dog? (CHAMPS_T1_Q45F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q45HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
46. Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push-ups)? (CHAMPS_T1_Q46F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q46HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
47. Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)? (CHAMPS_T1_Q47F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q47HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
48. Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)? (CHAMPS_T1_Q48F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q48HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours
49. Play basketball, soccer, or racquetball (do not count time on sidelines)? (CHAMPS_T1_Q49F) ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL hours a week did you usually do it? ➔ (CHAMPS_T1_Q49HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

PARTICIPANT ID_____ ; DATE: _____

In a typical week during the past 4 weeks, did you …							
50. Do other types of physical activity not previously mentioned (please specify)? (CHAMPS_T1_Q50F) _____ ☐ **YES** How many TIMES a week?_____ ➔ ☐ **NO**	How many TOTAL <u>hours a week</u> did you usually do it? ➔ (CHAMPS_T1_Q50HR)	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours

Thank you for your attention and sharing your perspectives. Your answers will greatly contribute to this wellness promotion research project.

_____

You have now completed the written part of this data collection period.

The last part of this session involves observing you sit, walk, and make other simple movements. I will guide you through these movements and observe you.

Ready~Steady **Data Collection Packet Part III(time 1)**

TUG : Usual pace and *TIMED* ***SENSOR (start time: _____)***
Time in **Seconds** _____ (TUG_T1_Time)
Use of Aid: _____None (0) _____ Walker (1) _____Cane (2) (TUG_T1_Aid)

Repeating Chair Stand: *TIMED*
Time: _____sec (if five stands are completed) (SPPB_T1_CS_SEC)
# of Stands Completed: 1 2 3 4 5 (SPPB_T1_CS_N)

Semi tandem Stand (one foot ½ in front of the other) (SPPB_T1_ST)
TIMED Circle one number:
2. Held for 10 sec **1**. Held for less than 10 sec; number of seconds held _____ **0**. Not attempted

---

Side-by-Side stand (okay to move arms, bend knees, but try not to move feet) (SPPB_T1_SBSS)
TIMED Circle one number:
2. Held for 10 sec **1**. Held for less than 10 sec; number of seconds held _____ **0**. Not attempted

---

Tandem Stand (one foot in front of the other or heel-toe as they say) (SPPB_T1_TS)
TIMED Circle one number:
2. Held for 10 sec **1**. Held for less than 10 sec; number of seconds held _____ **0**. Not attempted

---

8 foot Walk (use cane or other walking aid and your usual pace) (SPPB_T1_WALK_SEC)
TIMED and SENSOR (Start time: _____)Total Time (sec)

Sitting To Standing (try not to use your hands) **Circle Answer**: (BBS_T1_1)
4 able to stand without using hands and stabilize independently
3 able to stand independently using hands
2 able to stand using hands after several tries
1 needs minimal aid to stand or stabilize
0 needs moderate or maximal assist to stand

Standing Unsupported with feet shoulder width apart ***TIMED*** **2 MINUTES**
Circle answer (BBS_T1_2)
4 able to stand safely for 2 minutes
3 able to stand 2 minutes with supervision
2 able to stand 30 seconds unsupported
1 needs several tries to stand 30 seconds unsupported
0 unable to stand 30 seconds unsupported

Sitting With Back Unsupported But Feet Supported On Floor Or On A Stool
(BBS_T1_3)
If a participant is able to stand 2 minutes unsupported, score **4** points for sitting unsupported. Skip this
TIMED **- 2 MINUTES**
4 able to sit safely and securely for 2 minutes
3 able to sit 2 minutes under supervision
2 able to able to sit 30 seconds
1 able to sit 10 seconds
0 unable to sit without support 10 seconds

Standing To Sitting (please sit in chair) (BBS_T1_4)

4 sits safely with minimal use of hands
3 controls descent by using hands
2 uses back of legs against chair to control descent
1 sits independently but has uncontrolled descent
0 needs assist to sit

Transfers (pivot using one chair with arm rest and one without or bed/ chair) (BBS_T1_5)

4 able to transfer safely with minor use of hands
3 able to transfer safely definite need of hands
2 able to transfer with verbal cuing and/or supervision
1 needs one person to assist
0 needs two people to assist or supervise to be safe

Standing Unsupported With Eyes Closed ***TIMED-10 SECONDS*** ***(***(BBS_T1_6)

(Please close your eyes and stand still for 10 seconds)

4 able to stand 10 seconds safely
3 able to stand 10 seconds with supervision
2 able to stand 3 seconds
1 unable to keep eyes closed 3 seconds but stays safely
0 needs help to keep from falling

Standing Unsupported With Feet Together ***TIMED-60 SECONDS*** (BBS_T1_7)

(Place your feet together or as close as you can and stand without holding on).

4 able to place feet together independently and stand 1 minute safely
3 able to place feet together independently and stand 1 minute with supervision
2 able to place feet together independently but unable to hold for 30 seconds
1 needs help to attain position but able to stand 15 seconds feet together
0 needs help to attain position and unable to hold for 15 seconds

Reaching Forward With Outstretched Arm While Standing (BBS_T1_8)

(Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can without moving your feet or shoulder. And do not touch the ruler when reaching forward- **When possible, ask participant to use both arms when reaching to avoid rotation of the trunk)**

4 can reach forward confidently 25 cm (10 inches)
3 can reach forward 12 cm (5 inches)
2 can reach forward 5 cm (2 inches)
1 reaches forward but needs supervision
0 loses balance while trying/requires external support

Pick Up Object from The Floor From A Standing Position (BBS_T1_9)

(Are you comfortable bending over the pick something up off the floor? Pick up this roll of tape in front of your feet)

4 able to pick up slipper safely and easily
3 able to pick up slipper but needs supervision
2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently
1 unable to pick up and needs supervision while trying
0 unable to try/needs assist to keep from losing balance or falling

Turning To Look Behind Over L & R Shoulders While Standing (BS_T1_10)
Turn to look directly behind you over toward the left shoulder. Repeat to the right. (Examiner may pick an object to look at directly behind the participant to encourage a better twist turn.)

4 looks behind from both sides and weight shifts well
3 looks behind one side only other side shows less weight shift
2 turns sideways only but maintains balance
1 needs supervision when turning
0 needs assist to keep from losing balance or falling

Turn 360 Degrees ***TIME EACH CIRCLE*** (BBS_T1_11)
(Turn completely around in a full circle. Pause. Then turn a full circle in the other direction)

4 able to turn 360 degrees safely in 4 seconds or less
3 able to turn 360 degrees safely one side only 4 seconds or less
2 able to turn 360 degrees safely but slowly
1 needs close supervision or verbal cuing
0 needs assistance while turning

Place Foot On Stool While Standing Unsupported ***TIMED*** (BBB_T1_12)
(Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times. Watch while I demonstrate. Now go ahead and try yourself.)

4 able to stand independently and safely and complete 8 steps in 20 seconds
3 able to stand independently and complete 8 steps in > 20 seconds
2 able to complete 4 steps without aid with supervision
1 able to complete > 2 steps needs minimal assist
0 needs assistance to keep from falling/ unable to try

Standing Unsupported One Foot In Front ***TIMED—30 SECONDS*** (BBS_T1_13)
(Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the participant's normal stride width.)

4 able to place foot tandem independently and hold 30 seconds
3 able to place foot ahead independently and hold 30 seconds
2 able to take small step independently and hold 30 seconds
1 needs help to step but can hold 15 seconds
0 loses balance while stepping or standing

Standing On One Leg ***TIMED—STOP AT 15 SECONDS*** (BBS_T1_14)
(Stand on one leg as long as you can without holding on).

4 able to lift leg independently and hold > 10 seconds
3 able to lift leg independently and hold 5-10 seconds
2 able to lift leg independently and hold L 3 seconds
1 tries to lift leg unable to hold 3 seconds but remains standing independently.
0 unable to try of needs assist to prevent fall

Total score (maximum 56)—do not need to total this.