

Implementation of a Tai Chi Program for Community-Dwelling

Older Women

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Table of Contents

Contents

Implementation of a Tai Chi Program for Community-Dwelling Older Women 1

Abstract 6

Chapter I..... 7

Implementation of a Tai Chi Program for Community-Dwelling Older Women 7

Problem Statement..... 10

PICOT Question..... 12

Project Purpose 12

Theoretical Framework..... 13

Chapter II 23

Synthesis of the Literature 23

Exercise and Fall Prevention..... 23

Clinical Effectiveness of Tai Chi 24

Safety of Tai Chi..... 26

Cost Effectiveness of Tai Chi..... 27

Translation of TCMBB..... 28

Practice Recommendations 29

Chapter III..... 31

Quality Improvement 31

PDSA Change Model	31
Plan	32
Do	32
Study	33
Act	33
Setting	33
Mission, Organizational Structure and Culture	34
Organization Strengths and Weaknesses	35
Figure 2.	36
Organizational and Community Need	36
Stakeholders	37
Support	37
Short-term and Long-term Objectives	38
Budget	39
Table 1	39
EXPENSES	39
Project Design	40
Methods	40
Sampling	40
Intervention	41

Tools.....	42
ABC scale.....	43
Demographic characteristics.....	44
Table 2	45
Class evaluation.....	46
Procedure	47
Process	47
Statistical analysis	49
Chapter IV.....	50
Findings.....	50
Class Attendance	50
ABC scores.....	50
Table 3	50
Table 4	52
Table 5	53
Class Evaluations.....	54
Figure 3.	54
Table 6	55
Discussion and Project Evaluation	58
Feasibility and Translation.....	60

Adoption and Reach 61

Class Evaluations..... 63

Limitations 63

Significance and Strengths 64

Quality and Fidelity 65

Quality..... 65

Fidelity. 67

Ethics 67

Timeframe Evaluation 68

Dissemination and Sustainability..... 68

Conclusion 71

References..... 73

 Appendix A..... 81

 Appendix B..... 82

 Appendix C..... 84

Abstract

Older adult falls are a significant global and national public health concern. Research substantiates Tai Chi as effective exercise for improving balance thus reducing the fear and risk of falling and number of falls. Despite the evidence that Tai Chi is clinically and cost effective, it is not widely translated into community fall prevention programs, specifically not in programs offered by health systems. This quality improvement project evaluated a community-based implementation of a Tai Chi exercise program for older women at a healthcare system. A 12-week Tai Chi: Moving for Better Balance (TCMBB) program was implemented with community-dwelling women age 55 and greater. Participants attended a 60-minute Tai Chi exercise class twice a week for 12 weeks. A quasi-experimental pre- and post-test design was used to measure the effect of Tai Chi exercise in individual's perceived balance confidence in performing 16 functional tasks at baseline and at 12-weeks following the Tai Chi intervention. Findings demonstrate an overall 7% improvement in perceived balance scores indicating a reduction in fall risk. The feasibility and successful translation of a TCMBB for community based older women was also demonstrated within a large, urban health system. Furthermore, the program was evaluated highly by the women who participated in the study. These findings demonstrate translation of research on Tia Chi and fall reduction to an effective, low cost, community-based fall prevention program for reductions in fall risks.

Keywords: fall risk reduction, older adults, older women, fall prevention program, Tai Chi, evidence-based

Chapter I

Implementation of a Tai Chi Program for Community-Dwelling Older Women

Injurious falls in older adults are a significant public health problem resulting in lost lives, reduced quality of life, increased caregiving burdens, and billions of dollars spent annually. Despite research describing the causes, risks, and the effectiveness of fall prevention interventions, falls continue to be the leading cause of injury and death in older adults (Centers for Disease Control [CDC], 2015). Exercise-focused fall interventions are supported by public health authorities and healthcare professionals, but obstacles to disseminating and translating these interventions into clinical and community practice remain (Li, 2016).

The negative impact of falls and related injuries is significant. Schiller, Kramarow, & Dey (2007) reported that as many as 32% of older adults will require assistance with activities of daily living after experiencing a fall related injury, many up to six months. At six months post hip fracture only a third of individuals will return to pre-fracture activities of daily living (ADL), 27% will need ADL assistance, and 37% will die (Tang et al., 2017). Serious injuries, such as fractures and head injuries, occur in 20-30% of fall related incidents (Sleet, Moffett, & Stevens, 2008). The resulting fall related healthcare costs are expected to reach almost \$68 billion by 2020 (CDC, 2015b).

Given the substantial impact of falls, the importance of identifying risk factors and prevention strategies becomes important. Risk factors for falls have been well documented in the literature. Fall prevention starts with the identification of an individual's risk factors, many of which may be modifiable. Risk factors, as described by CDC (2015b), include intrinsic and extrinsic factors. Extrinsic factors such as lack of stair handrails, dim lighting or psychoactive medications are modifiable and should be considered when assessing risk. Intrinsic factors such

as advanced age, previous falls, muscle weakness, gait & balance problems, and fear of falling are modifiable with exercise. Exercise has been shown to reduce the incidence of falls by as much as 55% (Carande-Kulis, Stevens, Florence, Beattie, & Arias, 2015), leading to broad acceptance in the public health and clinical communities. Exercise for older adults is an important component of fall prevention. Organizations that provide guidelines for fall risk assessment and prevention include the American Geriatrics Society, Academy of Geriatric Physical Therapy of the American Physical Therapy Association, U.S. Preventive Services Task Force, National Council on Aging, and the Center for Disease Control.

Reducing the risk of falls for older adults with exercise programs is supported by research including, randomized-controlled studies (RCT's) and systematic reviews. These are described in the CDC's Compendium of Effective Fall Interventions (CDC, 2015b): What works for Community-Dwelling Older Adults. Listed as one of the fourteen evidence-based programs is a Tai Chi program created specifically for improving balance and decreasing fall risk; Tai Chi: Moving for Better Balance (TCMBB). Developed by Fuzong Li with CDC funding, TCMBB is an 8 form, simplified sequence developed from traditional Tai Chi.

Tai Chi is an ancient Daoist philosophical term symbolizing the interaction of the yin and yang, thought of as complementary opposites (Yang, 1961). The Tai Chi fundamentals of hardness comes from softness, and quickness comes from slowness are concepts in yin and yang. The slow movements characteristic of Tai Chi are, paradoxically, necessary for speed and agility (Yang, 1961), Although Tai Chi originated in China as a martial art, it is a holistic art that integrates physical, mental, and spiritual components, balancing the yin (spiritual) and yang (physical).

Tai Chi originated more than 300 years ago but has evolved into its current practice of flowing meditative movements and breathing techniques practiced for centuries by millions of Chinese to cultivate health and wellbeing (Yang et al., 2014). The Tai Chi forms consist of choreographed slow movements that are practiced using a variety of motor skills, foot work, and direction of motion (Yang, 1961). The movements are meditative, focusing on mind-body and body-environment interactions (Bubela, Sacharko, Chan, & Brady, 2017). The practice is designed to promote a smooth and balanced flow of energy throughout the body, promote better control of bodily movements, and to be more aware of the space through which the body is moving (Wolf, Coogler, & Tingsen, 1997). Wolf, Coogler, & Tingsen (1997) describe three basic principles that apply to all forms of Tai Chi. First, the body should be extended yet relaxed, with awareness of trunk alignment and deep breathing. Second, an alert but calm mind is required as one becomes more aware of the presence and movement of the body within space. Third, Tai Chi requires coordination of body segments through sequencing of postures. The movements are performed while maintaining a semi squat position with controlled weight shift and axial rotations progressing from the waist to extremities (Bubela, Sacharko, Chan, & Brady, 2017).

The benefits of Tai Chi as a form of exercise that promotes wellbeing has been given attention by Western science since the late 1990s (Wolf, Coogler, & Tingsen, 1997). A randomized controlled trial of TCMBB among adults aged 70 and older provided the initial evidence for the effectiveness of a shortened 24 form Tai Chi program. Participants in the Tai Chi program experienced fewer falls and less injurious falls, improved balance, physical performance, and fear of falling. Sixty-minute sessions were held three times per week for six months (Li et al., 2005). Subsequently, a shortened 12-week, simplified 8 form TCMBB has

also been developed and shown to be effective in reducing falls in community settings (Li et al., 2013; Gallant, Tartaglia, Hardman, & Burke, 2017). The shorter program length, the fewer number of forms, and ability to train novice Tai Chi instructors, may facilitate adoption and translation into community settings.

Although the growing body of literature supports the use of Tai Chi for improving balance and lowering fall rates, these programs are not widely disseminated as community and clinical practices. Implementing sustainable programs that target the older population is the next step in the translation of the evidence into community practice, and must be studied (Li, 2015). Translation problems such as insufficient expertise to roll out a community exercise program and inadequate infrastructure to integrate the program (Li, 2015) have been identified as obstacles and should be carefully considered and addressed when designing a community program. This project aims to translate TCMBB for older adults into a community setting while addressing translation barriers in the project plan.

Problem Statement

Despite the consensus on the magnitude of the problem, falls continue to be the leading cause of injury for older people, and the most prevalent cause of non-fatal trauma-related admissions to the hospital. The CDC (2015a) reports that about 25% of Americans over the age of 65 fall each year and the likelihood of falling increases with age, resulting in over 2.8 million injuries every year with fall related costs expected to reach almost \$68 billion by 2020. The US Census bureau (2018) estimates that the population of those 65 and older will nearly double in the next 30 years. The fastest growing group of older adults are those 85 years and older. It is expected that the number of falls in the aging population will rise proportionally, supporting the claims that this is a significant public health issue.

Unfortunately, a fall can have disastrous health and financial consequences for an older adult. The economic costs of medically treated fall injuries among older adults are substantial with the average hospital costs now reaching over \$30,000 (Burns, 2018). Every fall averted by an intervention has the potential for significant cost savings.

The rate of non-fatal falls disproportionately affects women (Burns, 2018). Further, the risk for osteoporotic fractures increases after menopause (Gallagher & Tella, 2014). Yet, despite the abundance of evidence describing the magnitude of this public health concern, injury prevention efforts receive less attention and fewer resources than other prevention efforts for cancer and other diseases (American College of Surgeons, 2014). Consequently, few of the CDC recommended evidenced-based interventions have been adopted by clinicians or health systems (Li, 2013). This is also the case in West Michigan. This author found evidence of CDC recommended fall prevention activities in the West Michigan area such as Tai Chi and Matter of Balance exercise classes at senior centers and the West Michigan Area Agency on Aging. In addition, some of the area hospitals offer Matter of Balance classes. These classes, although evidence-based fall prevention exercise programs, are not linked to the clinical care of older women, specifically post-menopausal women, aged 55 and older. The result of this lack of integration likely leaves many older women without access to fall prevention programs that could effectively reduce their fall risk and may also improve other health indicators that place them at risk for falls.

Translation of community evidence-based fall prevention programs offer cost effective strategies for reducing the risk and number of falls. The evidence that falls of older community-dwelling adults are preventable with risk assessment and exercise has broad consensus from professional and governmental agencies (Li, 2016). Tai Chi exercise, specifically, has

demonstrated significant positive results in most studies, however, it has not been widely translated into community programs linked to clinical interventions. Translational studies implementing evidence-based Tai Chi exercise programs for fall prevention should be evaluated for effectiveness and sustainability in the community setting.

PICOT Question

The phenomenon of interest for this project is the translation of an evidence-based fall prevention Tai Chi program into a community setting. The PICOT question defining the scope of this project is: In community-dwelling women age 55 and over, will participation in a Tai Chi exercise program compared to no Tai Chi participation reduce subjective perceptions of risks for falls?

Project Purpose

The aim of this project was to implement a Tai Chi fall prevention program for community-dwelling women 55 years of age and older in an outpatient healthcare setting. The purpose of this project was to translate evidence supporting Tai Chi for fall prevention into practice and to evaluate subjective perceptions of variables of fall risks before and after participation in the program.

This proposed project leveraged CDC investments in fall prevention research, specifically the evidence-based program Tai Chi for older adults; Tai Chi: Moving for Better Balance (TCMBB) (CDC, 2017). The evidence for the effectiveness of Tai Chi for fall prevention and reduced fall risk is well documented as is the risk and prevalence of falls in women. However, translation and dissemination of a scientifically validated Tai Chi fall prevention program in the broader community have not been fully established. Thus, the primary objective of this translational quality project was to translate and evaluate effectiveness of an

evidence-based Tai Chi program, offered within a healthcare system, to women living in the community. Additional inquiry related to program reach, adoption, and sustainability was addressed by evaluating participant attendance, plans for participants to continue Tai Chi exercise in the future, participant satisfaction with the program, and the intent of the sponsoring organization to continue the program.

Theoretical Framework

The theoretical framework guiding this study, implementation of a Tai Chi program for community-dwelling older women, is the Meikirch Model. The Meikirch Model is a relatively new health promotion theory. It was developed in the town of Meikirch, Switzerland by Dr. Bircher and Dr. Hahn as a response to value-based healthcare and to address their beliefs that the quality, costs, and equity of medicine and public health were not rising at the same pace as scientific advancements in medicine (Bircher & Hahn, 2017). Rather than attributing an economic meaning to health, they proposed a conceptual framework where health is an emergent state of wellbeing (Bircher & Hahn, 2017, p. 3) with the individual person at the center of the model. The authors posit that the theory is in line with evidenced based medicine, person-centered care, and integrative medicine (Bircher & Hahn, 2017). Furthermore, the theory enhances existing models by providing a new definition of health focused on the individual and collective determinants. It is intended to improve person-centered care and can be used to improve health-supporting behavior (Bircher & Hahn, 2016).

The Meikirch model is based on five components; the demands of life, two individual determinants of health (biological and personally acquired potentials), and social and environmental determinants of health. This model is depicted in Figure 1:

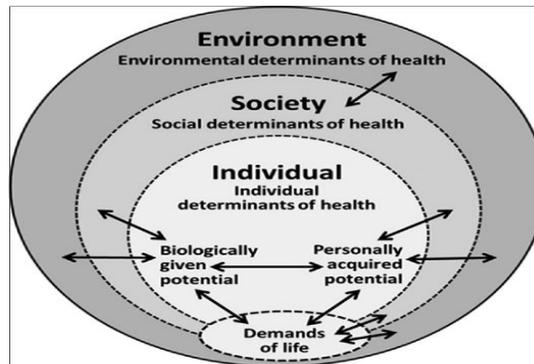


Figure 1. *Meikirch model depicting components of health*

Relationships and interactions between the various components are depicted in this model and must be considered in health and disease. The societal and environmental determinants surround the individual determinants in the model. The social determinants arise from society, influence the individual determinants and exploit environmental determinants such as global warming and polluted air. The social determinants include parents, family, friends, food, clothing, hygiene, housing, security, art, science, education, and the healthcare systems. The environmental determinants vary with geographical location and include environments both proximal and distal to the person. Factors such as beauty and available natural resources as well as pollution, storms, flooding, and arable land all influence health, however, it is the interactions of environmental determinants with the social determinants, the biologically given potential (BGP), the personally acquired potential (PAP), and the individual and collective demands of life that create the circumstances for self-organization and the emergence of health (Bircher and Hahn, 2017).

In this model, health occurs when both the biologically and the personally acquired potentials of the individual meet the demands of life. The individual's biologically and personally acquired potentials, however, must always be considered within complex relationships with society and the environment (Meikirch, 2015). "Health is a dynamic state of well-being emergent from conducive interactions between an individual's potentials, life's demands, and social and environmental determinants" (Bircher & Kuruvilla, 2014, p. 363). The five individual components of the model interact, providing ten complex interactions. Bircher and Hahn's (2017) concept of health puts the whole human being in the center; a human whose response to the demands and determinants of life contribute to wellbeing. They explain that the most important concept in the model is the demands of life. These demands of life, what humans require for life, fall into three categories. First, the bodily demands include nutrition, exercise or movement, clothing, vaccinations, housing, safety, and sanitation. Second, the psychosocial demands include social integration, development of personality, and mindfulness. Lastly, the third demand of life, the environmental demands include the production of food, access to potable drinking water, clean air, and shelter.

Bircher (Bircher & Hahn, 2017) explains that, because an individual's resources are required throughout life, they are referred to as potentials not as resources. Biologically given potentials (BGPs) are those acquired at birth whereas the personally acquired potentials (PAPs) are those that develop and change over time, such as our attitudes, values, and how we deal with personal defects. PAPs are basically our adaptations and everything we learn. PAPs describe all the physical, mental and spiritual capabilities the individual acquires over a lifetime (Bircher & Hahn, 2017) and influence BGPs. Throughout life, an individual's biological potential tends to

increase then decline while at the same time personally acquired potentials tend to consistently increase (Bircher & Kuruvilla, 2014).

A critical concept in the model is that health occurs when the individual has balanced biological and personally acquired potentials with the demands of life. These demands of life; food, water, potential for disease or dysfunction for example, must be met. As the biological potential that people are born with diminish with age and the acquired potentials increase, the individual is able to balance these with the demands of life. However, an imbalance leads to disease or death (Bircher & Hahn, 2017).

The development of one's PAP's is an important personal responsibility. One's PAP can compensate to some degree for BGP deficiencies, such as aging and disease. An individual who successfully uses their PAPs to meet the demands of life will influence their health as the body ages or is afflicted with disease or accidents. Personal responsibility plays a key role in the responses. However, individual responsibility is only one PAP influencing an individual's success in meeting the demands of health. Shared responsibility is defined as the links between the individual, societal, and environmental determinants and must all be considered when using the Meikirch model. Adaptations resulting from complex interactions between the components in the model ideally result in wellbeing (Bircher & Kuruvilla, 2014). It is the interacting components that comprise the models' complex adaptive system (CAS) (Bircher & Hahn, 2017).

When health is viewed from a CAS organismic perspective, it is a dynamic state that evolves, not by managing PAP's, but rather by influencing them and providing the circumstances within the whole system that allow positive adaptive responses to flourish. An organismic view of health recognizes the concept of "organized complexity" (Capra, 1996, p. 28) where multiple levels of organized systems, all with their own unique properties, form a whole. Each level has

its own properties and unique complexities that interact with other levels in the system in unique ways where new properties emerge (emergence) (Capra, 1996). In the Meikirch model, health is embedded and contextualized by the individual who is then embedded in their society and environments. It is influenced and emerges from the “conductive interaction” between the various levels of organized systems within the whole. For example, the interactions between the BGPs, social, and environmental determinants (Bircher & Hahn, 2017) all influence health as new properties emerge. The most important part of the model is that the individual is at the center. Surrounding and connecting with and impacting the individual are the social and environmental determinants, all in complex interactions with the demands of life. As such, health must be contextualized with the whole of the individual’s potentials, life’s demands, society, and environment (Burcher and Kuruvilla, 2014).

How an individual manages and adapts to biologically acquired deficiencies is a function of personally acquired learned behaviors, attitudes, values, and skills in interaction with BGPs. In this respect, PAPs influence the biological body for instance, how behaviors determine gene expression. Individuals who understand their situation may positively influence their health using their PAPs to meet the demands of their particular life situation. For example, an individual who exercises and eats healthy changes the biologically given potentials in a different manner than the individual who does not exercise and eats a diet low in nutrition.

The distinction between the biological and personally acquired potentials cannot be split into body and mind (Burcher and Kuruvilla 2014). An example of a concern to the BGP primarily would be the surgical repair of a fall related fracture (Bircher & Hahn, 2017). Such an intervention alone is not sufficient for overall health. Wound healing, innate bone repair, response to surgery, rehabilitation after the surgery and, importantly, prevention of injuries from

occurring in the first place or in the future, are within the realm of PAP and reflect the complex adapting and evolving effects of complexity science (Bircher & Hahn, 2017). While BGPs may be influenced and recreated by interactions within the larger system, these interactions create the capacity for adaptation, allowing the individual to continually change and modify as characterized by self-organization and emergence (Engebretson & Hickey, 2017). This is characteristic of non-linear, self-organizing CASs resulting in gradual evolution, change, and adaptation (Capra, 1996; Bircher & Hahn, 2017).

The interacting agents are described by Engebretson & Hickey (2017) as the units or components within a CAS. They may be as small as molecules or as large and complex as a biological system. Each agent is part of another agent or part that make up another part, all dynamically interacting and evolving within their environments and giving rise to new patterns (Engebretson & Hickey, 2015). This characteristic of CASs is embeddedness and as such a CAS must be considered in its wholeness. Therefore, an individual, using the Meikirch model, is a CAS embedded within a family or society, which is further embedded within the larger community or environment. These nested systems are referred to as levels of embeddedness in complexity science (Engebretson & Hickey, 2017). A change in any of the systems can affect the other systems, some with greater effect. Consistent with CAS, an individual must always be seen in the context of the systems and environments in which it exists and cannot be deduced from any one part.

Health may emerge from non-linear interactions of the embedded agents. Learning new behaviors such as those in a Tai Chi class or the administration of insulin in diabetes are examples of the adaptation process that in turn leads to more adaptation as non-linear interactions between systems occur. In the Meikirch model, PAPs adapt, evolve, and adjust to

changing circumstances. This process, whereby personal growth and self-management may gradually emerge, lacks predictability as small actions may lead to large effects and conversely, large actions may lead to small effects (Engebretson & Hickey, 2017, p. 123). For example, a caring response by a healthcare provider to a stressed or anxious patient may lead to larger positive responses from the patient, responses that may be unrelated to the stressful situation, but emerge in such a way as to create new positive change. Positive responses to new challenges that successfully evolve, represent personal growth in the Meikirch model which continues throughout life.

Adaption of the system is influenced by many factors, inputs, feedback loops, and interactions resulting in non-linear responses that can result in change and evolution, represented as personal growth or self-organization. For an individual, this results in adaptation and adjustment to difficult situations or life's demands, as in the case of aging. Throughout life, continuous adaptation occurs with health emerging from adaptation to the complex dynamic interactions of PAP, environment, society, and the individual's BPG (Bircher & Hahn, 2017, p. 3).

As with any CAS, the overall performance of this system cannot be deduced from the performance of any one part. A CAS must be considered in its wholeness. The Meikirch model proposes that all five components and all ten complex interactions are constantly changing and leading to adaptations and change in any of the system components. Interactions within the system can be influenced or re-created as for instance, by a medical doctor who surgically repairs a hip fracture or, as proposed in this project, by implementing a Tai Chi Program. Or, improved balance that occurs with the practice of Tai Chi which is regarded as aspects of BGP, may evolve and improve as the individual interacts with the societal, environmental, and life's demands as

components of the model. The individual's PAP, such as the motivation, discipline, learning and practicing, will influence the further process of evolution and adaptation of the results from Tai Chi exercise. Therefore, when viewed holistically as influencing and interacting within a CAS, Tai Chi exercise is consistent with the holistic practice of Tai Chi art and philosophy.

Tai Chi, although originally created as a martial art, is described by master Yang (2005) as a holistic art that develops and informs one's life. The balance of yin (spiritual, internal) and the yang (martial, external) aspects of Tai Chi are linked in this holistic art where the physical, mental and spiritual components are integrated into the practice (Yan, 2015). Therefore, Tai Chi training exercises are designed to build the whole person. The physical aspects such as improvements in strength, balance, and coordination are developed and improved at the same time as mental and spiritual awareness, confidence, and tranquility (Yang, 2005). In this respect, Yang (2005) postulates there is no difference between practicing for health and practicing for martial arts. The two are inseparable in this holistic practice (Yang, 2005) making Tai Chi an ideal intervention for fall prevention.

For this project, the complex, dynamic interactions between the components of the model can be exemplified. Specifically, the interactions between the individual, societal, and environmental determinants are considered in the development of strategies for the successful implementation of a Tai Chi exercise program addressing the largest cause of injury and death in older adults, namely falls. The implementation of a Tai Chi program within a large health system, provides a societal response to a significant public health issue. The availability of the Tai Chi program may render personal growth, in response to aging and falling, easier for the individual. The program is a response to a shared goal of the individual wanting to improve their health status and the health system whose mission is to improve the health of the community.

The provision of health-promoting Tai Chi classes for older women is primarily an aspect of a societal determinant. Marketing, program promotion, leadership for program development and organization, and provision of competent well-trained instructors are also societal contributions of the healthcare.

In the Meikirch model, an individual's response to the inevitable decline in biological potential and fall risk as a life demand is influenced by PAPs such as personal responsibility, initiative, ability but also interactions from other components in the system and life's demands. This project aimed to influence the individual, societal, and environment determinants of the personal system. Although many PAP's such as initiative are required by the individual to sign up and attend the Tai Chi exercise program my project does not aim to influence these factors. It does aim to make it easier to attend the class by implementing the program in a convenient, accessible community setting and by thoughtfully considering aspects of program planning such as promotion, marketing, and funding. My project also aims to influence the participants motivation and socialization once in the program by providing a safe, positive, encouraging environment where socialization, fun, and empathy are provided along with Tai Chi exercise instruction. In addition to the positive psychosocial health benefits, these factors may reduce attrition. Attendance and participation are key to the ability to reduce an individual's fall risk with Tai Chi exercise. Further, by providing an accessible Tai Chi program, embedded within a community (societal) CAS, this class provides a resource for older women who desire to improve their health status and biological potential by reducing their fall risk. Finally, consistent with CAS and the Meikirch model, as individual fall risk and the number of injurious falls in a community are reduced, there may be effects on embedded community systems such as a

reduction in hospital admissions, healthcare costs, and burdens to families caring for injured patients.

Chapter II

Synthesis of the Literature

The literature search for this project began with systematic computer searches conducted in PubMed, CINAHL, Cochrane Review databases, and Google Scholar. The data bases were searched for English-language articles published between 2012 and 2017. Key words used included fall risk reduction, older adult falls, fall prevention, and Tai Chi. In addition, reference lists from relevant studies and resources were reviewed for potential contributions. Community Tai Chi fall prevention, intervention, and implantation programs were considered that (a) used the simplified 12-form Yang style Tai Chi or Tai Chi Moving for Better Balance; (b) included older adults living in the community, age 55 or older; (c) measured effectiveness of Tai Chi in reducing fall risk; and (d) studied translation of evidence-based Tai Chi programs into the community. Twenty-nine articles were included in the synthesis.

The synthesis was organized by review of primary research articles including systematic reviews. A criteria-based checklist guided the appraisal of Tai Chi program characteristics, effectiveness in reducing fall risk, and translation potential. Specific indicators for the systematic reviews included research question, search strategy, inclusion and exclusion criteria, key findings, recommendations and level of evidence. Primary review indicators included research question, theoretical foundation, research design, key findings, recommendations, and levels of evidence.

Exercise and Fall Prevention

The effectiveness of exercise programs for fall prevention in older adults is well established. Sherrington, & Tiedemann (2015) in a systematic review of the literature concluded that general non-specific exercise interventions prevent falls in the older population. They further

conclude that group exercise, home safety, and multifactorial interventions all prevent falls in community-dwelling older people at an increased risk of falls. Additional systematic reviews (Guirguis-Blake, Michael, Perdue, Coppola, & Beil, 2018; Gillespie et al., 2009) also support the association of exercise programs with fall-related benefits, specifically reduced rates of falling and risk of falling, in older adults.

Clinical Effectiveness of Tai Chi

Clinical effectiveness of Tai Chi has been demonstrated by several studies. Wolf, Barnhart, Kutner, McNeely, & Xu (1996) and Taylor-Piliae et al. (2014) are two early randomized-controlled studies (RCT's) looking at Tai Chi. Both studies were able to show a sustained reduction in fall frequency.

While the Taylor-Piliae et al. (2014) Tai Chi study intervention is twelve weeks rather the six months reported in the Wolf et al. (1996) study, both RCTs measured the occurrence of falls or fall frequency after Tai Chi. Additionally, the studies also used different study participants. The Wolf et al. (1996) RCT examined the impact of Tai Chi on the occurrence of falls as a secondary outcome in persons aged 70 and older living in the community. After adjusting for fall risk factors in this study, Tai Chi was found to reduce the risk of multiple falls by 47.5%.

In the Taylor-Piliae et al. (2014) RCT, the study population included 145 community-dwelling survivors of stroke (aged 50 years) who were at least three months post stroke. The participants were randomly assigned to one of three groups; a 12-week Tai Chi exercise class, a strength and range of movement (SS) exercise, and usual care (UC). Physical function fall rates and quality of life was compared among the groups. In this study, the Tai Chi participants had two thirds fewer falls (five falls) than the SS (14 falls) and UC (15 falls) groups ($\chi^2=5.6$, $P=.06$).

Further early evidence for the effectiveness of Tai Chi in reducing falls over a sustained period is provided by Li et al., (2005) in an RCT of two hundred fifty-six healthy, physically inactive older adults aged 70–92 (mean age, 77.48 years; SD, 4.95 years). The participants were recruited from a health system and allocated to a Tai Chi intervention group or stretching exercise group acting as the control. A key finding of this study is that improvements in measures of functional balance at the intervention endpoint significantly reduced the participants' risk of falls during the 6-month postintervention period, compared with those in the control condition (odds ratio (OR), 0.27, 95% confidence interval (CI), 0.07– 0.96 for Berg balance scale; OR, 0.27, 95% CI, 0.09–0.87 for dynamic gait index; OR, 0.20, 95% CI, 0.05– 0.82 for functional reach) (Li et al., 2005). The authors conclude that reduced fall frequency is associated with improved functional balance after Tai Chi training for six months, three times per week and that the positive benefit of Tai Chi remained at a six-month post-intervention assessment.

Following this, Bubela et al. (2017) performed a quasi-experimental (QE) study also demonstrating improved performance on measures relating to fall risk. These measures included strength, balance, functional mobility, and fear of falling in older community-dwelling adults who participated in a Tai Chi program. This study included a control group of participants who did not participate in the Tai Chi program. After 2 times per week for 12 weeks of Tai Chi, the Tai Chi group experienced significant improvement in the functional measurements. The total balance confidence score did not change; however, many individual items did reach a significant change.

In conclusion, hi level studies have shown Tai Chi to be clinically effective for improvements in fall related parameters for community-dwelling older adults. In an updated

systematic review of the literature on the effects of interventions designed to reduce the incidence of falls in older people living in community, Gillespie et al. (2009) found that for Tai Chi the risk of falling was significantly reduced (risk ratio 0.71, 95% CI 0.57 to 0.87; four trials; 519 participants) and the rate of falls was borderline statistically significant (rate ratio 0.72, 95% CI 0.52 to 1.0: five trials, 1563 participants).

Safety of Tai Chi

Tai Chi is frequently cited in the literature as a safe intervention, however, there is often poor and inconsistent reporting of adverse events. Three studies were found that addressed adverse events (AEs). Two of the studies (Wayne, Berkowitz, Litrownik, Buring, & Yeh 2014; Guirguis-Blake et al., 2018) conclude that improvement in the reporting of AEs is required to draw definitive conclusions about the safety of Tai Chi, but in one study (Taylor-Piliae & Coull, 2012), the authors conclude that 24-posture Yang style Tai Chi can be safely performed by stroke survivors.

The AEs reported in the two systematic reviews of RCTs on Tai Chi safety (Wayne et al., 2014; Guirguis-Blake, 2018) were often minor, such as knee and back pain. No intervention-related serious AEs were reported. Wayne et al. (2014) suggest that it is difficult to draw more definitive conclusions about the safety of Tai Chi until monitoring and reporting of adverse events are reported in future studies. The infrequency of reported AEs is also described in the Guirguis-Blake et al., 2018 Systematic Review for the US Preventive Services Task Force Harms. In this study, the authors concur with the conclusion of the previous study by Wayne et al. and note that AE's in multifactorial and exercise trials are rarely reported but generally included minor musculoskeletal injuries.

The third Tai Chi safety study (Taylor-Piliae & Coull, 2012), a two-group, prospective pilot study with random allocation of stroke survivors assigned to the Tai Chi intervention had no falls or other adverse events. The authors conclude that 24-form Yang style Tai Chi can be safely performed by stroke survivors (Taylor-Piliae & Coull, 2012) however, adverse events other than falls are not explicitly defined in this study.

In conclusion, while AEs are infrequently reported in Tai Chi studies, they are generally minor and musculoskeletal in nature. The evidence shows Tai Chi is unlikely to result in a serious adverse event (Wayne et al., 2014), however, better and consistent reporting of AEs in future studies will enhance conclusions about the safety of Tai Chi.

Cost Effectiveness of Tai Chi

Fall related medical costs are expected to exceed \$67.7 billion by 2020 (National Council on Aging, 2016). Burns (2018) estimated the incidence, average cost, and total direct medical costs for fatal and non-fatal fall injuries in hospital, ED, and out-patient settings among U.S. adults aged 65 or older in 2012, by sex and age group and to report total direct medical costs for falls inflated to 2015 dollars. Cost effectiveness and impressive return on investment for evidence-based falls programs has been established by one team of investigators in a large population-based study. Carande-Kulis, Stevens, Florence, Beattie, & Arias, (2015) in a retrospective analysis of 2,610,300 falls among people age 65 and older in 2000, showed reduced medical costs. Direct medical costs were estimated at \$11,502 per patient (adjusting for inflation in 2012). Three fall interventions were chosen using the following 3 criteria; highly effective based on RCT's, feasibility/translatibility, appropriateness for older adults. The three programs reviewed were the Otago Exercise Program, Tai Chi Moving for Better Balance (TCMBB), and Stepping On. The net benefit and return on investment (ROI) estimated for each of the 3

interventions were calculated Net benefit was the benefit of averting fall-attributable medical cost and ROI was the percentage of return for each dollar invested. TCMBB had the highest ROI at 509%.

Translation of TCMBB

Evaluation of the adoption of evidence-based Tai Chi fall prevention programs, in community settings where the target population, older adults reside, is needed (Li et al., 2006). Gallant et al., 2017) studied the implementation of TCMBB in three counties by health departments and offices for aging. The participants were an average age of 73 years and mostly (93%) white females. Program effectiveness was evaluated by measuring outcome variables for functional mobility and balance measures pre-post intervention. These were: Timed Up and Go (TUG) test, Functional Reach, and Activities-specific Balance Confidence (ABC) scale for all participants (n=126) and program completers (n=76). Significant pre-post improvements were achieved in all outcome variables. Evaluation of adoption and reach were achieved by measuring attendance and satisfaction with the class. Mean attendance was 70% of class sessions and 73% (n = 92) of participants reported being somewhat or very satisfied with the class. The authors also reported that the health departments and offices for aging did not have any difficulty recruiting participants.

Another study investigating the translation and dissemination potential of an 8-form Tai Chi program measured the proportion of healthcare providers who made referrals to the program (Li et al., 2013). The providers were provided education about the program and class enrollment procedures. Secondary outcomes measured included the proportion of referred patients agreeing to participate and enrolling in the program, and measures of program implementation, maintenance, and effectiveness, measures of falls, balance, gait, physical performance, and

balance efficacy. A 62% adoption rate by the providers and 67% enrollment suggest success program adoption and reach. A 75% retention rate and a reduction in falls showed significant improvement from baseline in all outcome measures. This study demonstrates that a Tai Chi program for fall prevention can be successfully disseminated, with effective clinical outcomes, in a community setting.

There is a growing body of evidence that Tai Chi is an effective exercise for improving health, specifically, preventing injurious falls in older adults. Three studies found that the simplified, 12-week or 24-week TCMBB program demonstrated improved balance, lower fall rates, and less fear of falling than controls (Wang et al., 2016; Taylor-Piliae et al., 2014; Li et al., 2008). The systematic reviews by Guirguis-Blake et al. (2018) and Gillespie et al. (2012) both showed exercise interventions were associated with a reduced risk of falling. Gallant et al. (2017) also suggests that the 12-week TCMBB for older adults can be effectively taught by novice instructors and Carande-Kulis et al. (2015) were able to show the cost effectiveness of Tai Chi exercise programs, while, Li et al. (2013) provided evidence that it is fully translatable in community settings. Further, Sherrington, & Tiedemann (2015) suggest that all older adults are likely to benefit from reduced fall risk, not just those at high risk for falls, from an exercise program. Translation of the TCMMB into community settings, an important next step, is gaining momentum. The quality improvement translational project proposed in this paper will build on the positive translational research results of Gallant et al. (2017) and Li et al. (2013) by offering a 12-week TCMBB fall prevention program for older adults.

Practice Recommendations

Based on the synthesis of the literature, it can be postulated that a 12-week evidence-based fall prevention Tai Chi program for women aged 55 and older can be effectively

implemented in a community setting. Measures of fall risk can be expected to be positively impacted in this population after participating in the program. Further, there is strong evidence supporting that the Centers for Disease Control (CDC) recommended TCMBB program can be taught by novice instructors and is a cost effective and safe intervention. Likewise, this program has both reach and adoption potential in a health care setting.

Chapter III

Quality Improvement

PDSA Change Model

The change model for this project was the Institutes for Healthcare Improvement's (IHI) Plan-Do-Study-Act (PDSA) framework. This model was chosen because it is used by many health care organizations as the framework for quality activities; including the one where this project will be implemented. The PDSA cycle is the structure or procedure for applying and testing this change project. It is a simplified, pragmatic version of project management that applies scientific methods to a small-scale project (Taylor et al., 2014). Each cycle of the PDSA identifies adaptations and informs the new cycle. It is an iterative process aimed at continuous improvement (Taylor et al., 2014).

The four independent steps in the process were informed by three questions that can be asked in any order (IHI, n.d.). The first question related to project aims or goals is; what the project is attempting to accomplish. The second question asks if the change is an improvement and lastly, what change can be made that will result in improvement. The Agency for Healthcare Research and Quality (AHRQ) (2015) provides a PDSA worksheet that includes these questions and was used as the framework for this project's implementation plan.

The responses to the three questions that inform the PDSA process include the following: In this project, a 12-week Tai Chi Moving for Better Balance (TCMBB) fall prevention program for women aged 55 and older will be implemented in a community setting. The purpose is to translate evidence supporting Tai Chi for fall prevention into practice and to evaluate subjective variables of fall risks before and after participation in the program. Reduction of fall risk was the

goal for the participants. At the completion of the program, reach, adoption, and sustainability were also addressed. The PDSA was broken down into the following components:

Plan.

1. Design a check sheet for the plan.
2. Plan the execution of the TCMBB with the organization, including marketing, registration, and rooms.
3. Plan the development of the welcome letter with implied consent information and the Activities-specific Balance Confidence (ABC) questionnaire, demographic data, and the identification questions.
4. Plan all details relating to space, time, persons involved in implementation of the TCMBB program. Classes will be held twice a week for 12 weeks. Each class will be 60 minutes.
5. Prepare for questions from participants.
6. Plan a potential problem-solving session with parties involved.
7. Plan for potential problems such as not enough participants, unable to run T-tests, instructor absenteeism.

Do.

1. Author an acceptable project proposal.
2. Obtain the necessary IRB and institutional approvals.
3. Follow through with marketing of the program.
4. Prepare the questionnaires and other materials such as the implied consent information, and class evaluation.
5. Execute the plan.
6. Complete measurements and assessments.

7. Observe the participants and note any adverse events, reactions, and attitudes. Consider what needs to be modified in the future.

Study.

1. Complete analysis of data, summarize what was learned, compare data to predictions.
2. Evaluate change process.
 - a. Agency responsiveness
 - b. Sustainability
3. Evaluate the findings in context of the local environment to develop effective improvements that are adapted for the local context (Taylor et al., 2014).

Act.

1. Consider changes or improvements that should be made before testing the next cycle? An example of a change would be to add a protocol for provider referral to the program or offer the class at a different time of day.
2. Respond to unforeseen consequences.
3. Write a sustainability and dissemination plan.

Setting

The setting for this project is the urban and suburban community of Grand Rapids, Michigan. Participants recruited from within this community are served by the largest health system in the area. This health system is a not-for-profit health system in West Michigan comprised of nine hospitals including; ambulatory and service sites; several physician groups; and a health plan. It is West Michigan's largest employer and offers a full continuum of patient

care services. As such, it has a large reach for participant recruitment, however, participants were not required to be a patient in the health care system to participate in the Tai Chi program.

The Tai Chi program was offered in an appropriately sized training room, for the activity and number of participants, at one of the health system's complexes. The facility is easily accessible from the main highway with accessible parking. The modern facility provides a comfortable and inviting setting for the classes.

Mission, Organizational Structure and Culture

The health care organization's mission is "to improve the health of the community we serve" (Spectrum Health", 2018). The support of this mission is evidenced by the organization's provision of \$204 million in community benefit during its 2012 fiscal year (Spectrum Health 2018). Reducing older adult injurious falls in the community contributes to the health and wellbeing of those served by the organization's community. Preventing falls reduces morbidity and mortality, enhances the aging adult's ability to remain active and live independently, improving both individual and social determinants of health. The purpose of this project was to translate the evidence-based TCMBB program in the organization's community which is congruent with and supports the organizations' mission.

This organization is also a medical research and teaching center accustomed to medical, nursing, and allied health students. They support an academic framework for teaching medical, nursing, and allied health students and for clinical, translational, and basic quality research activities. These research activities are supported by a research department with established alliances with a research institute and university college of human medicine. Their office of research assists researchers and those conducting quality improvement studies conduct their research or project. They assist with navigating the complexities of approval of human-subjects

protections, identification of funding sources, and compliance with applicable laws, regulations and policies.

Quality improvement (QI) and change projects are important and well supported at this organization. QI is heavily focused on the Centers for Medicaid/Medicare's Pay for Performance Measures with service line teams heavily engaged in collaborative improvement efforts with the quality department. The teams use the Plan Do Check Act (PDCA) tool as the framework for their quality improvement projects. The Quality department also tracks change projects supported by service lines and designated by the Spectrum Health IRB as a quality project rather than clinical research. They monitor and track these projects in a special software program in addition to providing guidance and staff support when appropriate.

Organization Strengths and Weaknesses

An evaluation of the healthcare organization's readiness for the implementation of this change project was conducted over a 6-month period with dialogue with the stakeholders included meetings, emails, and phone calls. The strengths of the organization included experienced leaders familiar with quality and research, strong commitment to their vision for improving the health of community, a physician leader dedicated to bringing Tai Chi to her patients, and a supportive foundation. Weaknesses included a complex organizational bureaucracy however, commitment of resources such as a research assistant assigned to assist with navigating this bureaucracy mitigated this weakness. Access for patients of the healthcare system and community members to an evidence-based Tai Chi for fall prevention program was an opportunity. A physician leader who was eager to provide Tai Chi to her older female patients was also an opportunity. Lastly, the readiness assessment identified several threats that were considered. These included the potential that the TCMBB program would not be funded and

therefore at risk of not being implemented. Significant bureaucratic and programmatic challenges existed requiring constant management and attention (see Figure 2 for SWOT analysis).

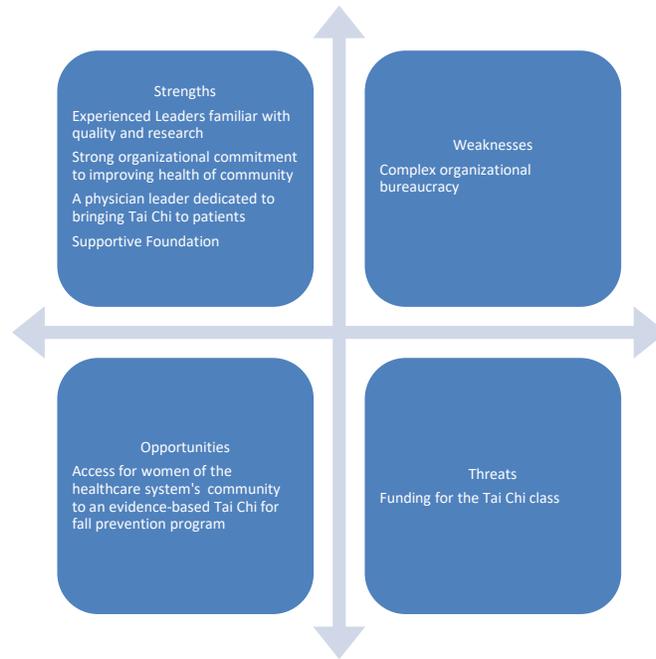


Figure 2. Organizational SWOT analysis of the West Michigan health system where this Tai Chi exercise study was implemented.

Organizational and Community Need

The need for this community project was recognized because the prevalence of older adults who are admitted to the hospital or die from injurious falls. Falls in older adults continues to be a significant public health issue despite evidence that fall prevention programs such as Tai Chi are effective. In the Grand Rapids community, the Area Agency on Aging, Senior Neighbors, community centers and senior living centers, and the YMCA have Tai Chi exercise classes that promote fall prevention. Depending on the program, there may or may not be a fee associated with the class. These programs are affiliated with a community health system with limited reach and referral potential. The healthcare systems all provided or are involved with the

provision of fall prevention classes as part of their trauma programs. For example, Matter of Balance classes are often offered several times a year as a community benefit. None of the programs are integrated into the health system, therefore lack the benefits of reach to the broader community with a marketing plan, funding support, outcome data showing effectiveness, quality improvement cycles, and participant satisfaction, and finally, sustainability plans.

Stakeholders

The primary stakeholders for this project were the older women in the community who will benefit from this Tai Chi program. Stakeholders, other than potential participants and those directly involved in this project, were identified and include the physicians and research staff of the sponsoring organization's Women's Health Department and Trauma Services Department, as well as the Area Agency on Aging, and the State of Michigan Region 6 Regional Trauma Network. Information about the study was shared with the stakeholders during several different meetings. Feedback regarding recruitment, project setting, and design was welcomed and integrated into the project plan as possible. Findings will be disseminated to stakeholders and participants after project completion.

Support.

Support for this fall injury prevention program came from the stakeholders and organizational leaders such as the Division Chief, Acute Care Surgery Director and Medical Director of Surgical Intensive Care Unit and Trauma, the Medical Director of Women's Health, and the executive leader of Spectrum Health Healthier Communities. This project falls under the auspices of Women's Health, a service line expanding its offerings of complementary and prevention services for women. Organizational support was obtained after I presented the idea for this project to the Division Chief and executive of Healthier Communities. A referral and

recommendation for the program was made to the Women's Health service line after which, support was confirmed by the medical director and research assistant. Several months of working through administrative details with the research assistant resulted in a plan to obtain IRB determination for the project. Foundation funding, space, marketing, and agreement on project time frame were agreed on. Sustainability plans included Foundation funding for the project, with plans to continue this source of funding or the creation a self-sustaining model where participants pay a nominal amount for instructor fees. This is a model currently being used successfully by other complementary therapies, such as yoga.

Short-term and Long-term Objectives

The short-term objectives of this project were to obtain the organizational support and funding required to implement the Tai Chi program for 12 weeks followed by implementation in October 2018. The long-term objectives included measurement of effectiveness, a plan for long term sustainability, dissemination of the results via presentations to the Ferris State University faculty and students, the Michigan Department of Health and Human Services (MDHHS), Bureau of EMS and Trauma, publication, and a poster presentation at the annual Michigan Trauma Symposium.

This Tai Chi fall prevention program, delivered in the community setting of a large health care system, has stakeholder and foundation support. Injurious falls continue to be a significant health concern in the project setting. There was interest from both the women's health and trauma departments in addressing fall prevention, especially as it related to women's health. The organizational culture is one which leads many innovative change and quality projects facilitating the acceptance and ease of project reach and implementation.

Budget

Funding for this program, from the health care organization’s Foundation, was granted. Funding will pay \$60.00 an hour for the instructor who is not conducting the study to provide a one-hour class, twice a week for twelve weeks. The instructor conducting the investigation did not receive financial reimbursement. The total budget projected for this project is \$1,744.00 for instructor costs.

Table 1

Budget

EXPENSES		REVENUE	
Salary and Benefits	\$1744.00	Grants	\$1,744.00
Supplies & Marketing	0	Institutional budget	0
Services	0		
Indirect	0		
Overhead	0		
Total Expenses	\$1,744.00	Total Revenue	\$1,744.00
Net Balance			0

Note. This budget reflects the direct operating costs for the Tai Chi exercise class. Other costs included marketing, a statistician, indirect administrative overhead costs, room rental charges, parking, and instructor training were not included because this was a Foundation sponsored program.

Other potential projects costs, discussed with the organization, included marketing costs, the cost of a statistician, indirect administrative overhead costs, room rental charges, and a small amount for supplies such as paper and pens. Foundation funded projects are not assessed these

costs, therefore, they were not included in the budget for this project. Had the funding source been a grant, either a governmental or sponsorship grant, these charges would have applied.

Project Design

There is empirical support that a 12-week TCMBB exercise program decreases fall risk in older adults living in the community. A QE design was used to answer the question: In community-dwelling women age 55 and over, will participation in a Tai Chi exercise program compared to no Tai Chi participation reduce subjective perceptions of risks for falls? This QE quality improvement project measured the same outcome, the score on the ABC scale (see Appendix C), in the same cohort over two points in time at baseline and following the intervention.

Methods

The effect of Tai Chi exercise on perceptions of fall risk was measured using a QE design in this quality improvement project. Participants attended a 60-minute Tai Chi exercise class twice a week for 12 weeks. Data was collected at baseline and at 12 weeks following the Tai Chi intervention. Fall risk, as assessed by rating balance confidence on 16 functional tasks, was measured using the ABC questionnaire. Class participation, participant satisfaction with the program, and demographic data was also used to analyze the translation of the program using the Plan-Do-Study-Act change model.

Sampling

Fifteen interested women, age 55 and older, were recruited from the geographical area of the sponsoring health system's main campus in West Michigan. The sample for this project was a convenience sample of community-dwelling women aged 55 and older who volunteered to participate in the Tai Chi exercise program. The participants were female, age 55 or older,

English speaking, and living in the community. There were no specifications related to ethnicity, income, educational status, or history with Tai Chi. Exclusion criteria included male gender, non-English speaking, and women younger than age 55.

Recruitment consisted primarily of posting program flyers (see Appendix A) promoting the Tai Chi exercise program. Promotion occurred both within the facility and outside of the health system such as in physician and clinic offices. Program flyers were posted in designated locations within the health care facilities including the cancer treatment center, the café in the main hospital, and the café and main lobby in associated hospital facilities. Program flyers were available at the cancer center yoga class and a community centered yoga class where one of the Tai Chi instructors for this program teaches yoga. The program was also advertised on the healthcare system's intranet as a community class offering. Finally, snowball recruitment methods were used where volunteers are recruited from word of mouth information flows.

Further recruitment occurred after persons registered for the Tai Chi class. A letter of explanation of the study was sent via email by the health agency administrative assistant explaining the study and offering the participants the opportunity to participate in the study. Persons registering to take the Tai Chi class were informed that they were free to take the class without participating in the study.

Intervention

The Tai Chi instruction protocol was implemented as specified in the Tai Chi for Therapy protocol (Sacharko, 2018). Tai Chi for Therapy consists of two main components; The CDC's Tai Chi Moving for Better Balance (TCMBB) protocol and an objective training assessment tool for the instructors. TCMBB was developed by Fuzhong Li of the Oregon Research Institute under a grant from the CDC (CDC, 2015b). The instructor training assessment tool was

developed by Laddie Sacharko, an experienced Tai Chi instructor familiar with, and certified by Dr. Li to teach TCMBB. Tai Chi for Therapy teaches the same 8-form and principal elements of posture and balance as those in the TCMBB, however, the addition of the training assessment tool provided objective performance criteria instructors use when teaching the forms (Sacharko, 2018).

The duration of the TCMBB program was twelve weeks. Classes met twice a week for 60 minutes each session. After participants signed in, the sessions began with a five-minute meditative centering exercise to focus participants on their breathing and allow them to enter a state of mental and physical readiness (Sacharko, 2018). The following class schedule as recommended by Sacharko (2018) was used: A 10-minute warm-up using traditional Tai Chi exercises and activities, review and practice of each exercise taught to date, followed by a sequence of same exercises, demonstration and practice of one new form, integrate the new form into the sequence, practice, ending with a cool down. The last 15 minutes of the class was dedicated to a cool-down which included practicing the learned elements with time allotted for questions and answers.

Participants were encouraged to perform the movements through their personal range of motion in which they felt safe. Chairs were available to use for balance or, if desired, to perform the postures while sitting on the chair. The instructors encouraged participants to ensure their own safety and offered chairs as needed while monitoring each class.

Tools

The purpose of this QE quality improvement project was to translate evidence supporting Tai Chi for fall prevention into practice and to evaluate subjective perceptions of variables of fall risks before and after participation in the program. Tools used to measure the study outcomes

included: A class attendance roster to measure program participation; the ABC questionnaire to measure self-perceptions of balance and fall risk; and, a post-class evaluation.

ABC scale.

While class participation, participant satisfaction with the program, and demographic data were evaluated, outcome data from the before and after ABC questionnaires (see Appendix C) were compared in the study analysis. Effectiveness of this program to improve subjective fall risk was measured by the change of the scores on the pre-Tai Chi and post-Tai Chi class ABC scale. The ABC questionnaire is a self-assessment that asks respondents to rate their confidence in performing 16 functional tasks (Bubela, Sacharko, Chan, & Brady, 2017). This measurement scale was chosen because it is a reliable indicator of fall risk, therefore, suitable for detecting loss of confidence in balance in more highly functioning seniors (Powell & Meyers, 1995). It has demonstrated test-retest reliability ($r=0.92$) and high internal consistency (Cronbach $\alpha=0.96$) (Fabre, Ellis, Kosma, & Wood, 2010). Internal consistency was also demonstrated by Huang & Wang (2009) with a Cronbach's alpha measured 0.96. This questionnaire is easy to use and requires little training, making it accessible for a community quality improvement project.

The Shirley Ryan Ability Lab, a large rehabilitation center and formerly the Rehabilitation Institute of Chicago, describes the purpose of the ABC scale as “a self-report measure of confidence in performing various activities without losing balance falling or experiencing a sense of unsteadiness” (“Activities-specific Balance Confidence Scale”, 2013, para 1). Participants were asked to rate their balance confidence for performing activities on the on 16 questions that begin with the stem: “How confident are you that you will not lose your balance or become unsteady if you...”? The Likert-type responses to the 16 questions can range

from 0% confidence, representing an activity the participant will not perform, to 100% confidence, representing complete confidence.

To score the participants' test, the sum of the scores were divided by the total number of items to provide an overall score (Shirely Ryan Lab, 2013). A score of 80% denotes a high level of physical functioning, 50-80% is moderate level, <50% is considered low level. A score of less than 67% indicates an older adult at risk for falling and is predictive of a future fall (LaJoie, 2004). The scores for all 16 questions and the total score were used in the analysis.

Demographic characteristics.

Demographic data describing the characteristics of the participants in the sample was collected with the ABC scale questionnaire: Age, race/ethnicity, highest level of education, previous Tai Chi experience, participation in regular exercise, and any falls or fractures from a fall after age 55. The race/ethnicity categories, obtained from The National Institutes for Health (NIH) (2015) are; American Indian or Native Alaskan; Asian, Black or African American; Hispanic or Latino; Native Hawaiian or other Pacific Islander and Whites. Table 2 shows the demographic information of the participants in this study. As shown in Table 2, demographic data showed an all-white, overall well-educated, active group of older women with a 67% history of falls after the age of 55. Most (67%) had never done Tai Chi before. The age range of those completing the course was 55 to 79 years with almost half in the 55 to 64 ranges and half in the 65 to 79 ranges.

Table 2

Baseline Demographic and Health-related Characteristics of Participants

Characteristic	Baseline (n = 15)		Completers (n=12)	
	Mean	n (%)	Mean	n (%)
Age, in years				
55-59	3	(20)	1	(8)
60-64	5	(33)	5	(42)
65-69	1	(7)		
70-74	3	(20)	3	(25)
75-79	3	(20)	3	(25)
80-84				
Ethnicity				
White	100%		100%	
Have done Tai Chi before.				
Yes	5	(33)	4	(33)
No	10	(67)	8	(67)
Broken Bone				
How much do you exercise?				
Not at all or very little	1	(7)	1	(8)
30-60 minutes/week	1	(7)	1	(8)
1-2 hours/week	4	(27)	3	(25)
2-3 hours/week	7	(46)	5	(42)

>3 hours/week	2	(13)	2	(17)
Have you fallen after age 55?				
No	6	(40)	4	(33)
Yes	9	(60)	8	(67)
Fall result in a broken bone	1		2	
Highest education level				
Some college	1	(7)	1	(8)
Technical Vocational				
Associates degree				
Bachelor's degree	9	(60)	8	(67)
Master's degree	5	(33)	3	(25)
Doctorate or Ph.D.				

Note. Baseline participants include all 15 of the study participants. The completers are the participants who completed at least 75% of the class sessions.

Class evaluation.

The class evaluation (see Appendix C) was designed to measure the overall satisfaction with the class, impact of the Tai Chi program, and obtain qualitative data from the open-ended question asking for additional feedback. The participants were encouraged to also write about perceived benefits of the Tai Chi exercise. For this project, participant satisfaction and perceptions of program quality measure the overall impact and program success.

Procedure

The procedures for this project were developed in collaboration with the sponsoring healthcare organizations' research assistant. The organization provided the staff (administrative assistant) for class registration. Once registered, a welcome letter (see Appendix B) from the class instructor with information about this class was emailed to the participant by the administrative assistant. The welcome letter included information about study and the option for registrants to participate. The instructor was available prior to the first class to answer questions and ensure participants understood implied consent and that they may leave the study at any time. Study participants were asked to complete pre and post-class anonymous surveys that were collected and safely stored by the instructor for analysis.

Process

Participants wanting to attend the Tai Chi program were registered by calling the phone number indicated on the promotional materials. The administrative assistant (AA) for the Women's Health Services registered the participants on a paper registration form. The participants name, phone number, and email were logged on the registration form. The AA also confirmed the participant was age 55 or greater and that the participant is English speaking. The participant was told that they will receive a welcome letter from the instructor. The welcome letter included information about the study, a request for their participation and notification that any questions will be answered. Participants were also requested to arrive 30 minutes early the first day of class to receive explanation about the Tai Chi study, have their questions answered, and complete the survey. They were also informed they should plan to stay 30 minutes longer on the last day for survey completion. If asked about the study, the AA could share that the instructor is a Ferris State University (FSU) Doctor of Nursing Practice student studying the

effect of Tai Chi on balance; that participation in the study is voluntary, and they can attend the Tai Chi class without participating in the study. If participating in the study the AA informed them to arrive 30 minutes early for the first class and that the study involves completing a 16-question survey at the beginning and end of the 12-week program-

The participants were provided space and time needed to complete the survey. The paper survey included a survey number, demographic information, three unique questions that ask for the participants mother's maiden name, the make of first car, and name of first pet. These questions could be used to match the participant's pre-class ABC questionnaire to the post-class ABC questionnaire and survey number should they forget the assigned number.

To ensure participant confidentiality, all surveys were anonymous, no names were collected. Each survey is identified with a number from 1 through 37. The participants were asked to remember their identifying number as it will be used to match the pre-survey to the post- survey. I asked they write it down or take a picture of it with their phone. Should they forget their number for the post-survey, the three identifying questions previously described can be used to find it. Lastly, the questionnaire did not contain any protected health information (PHI).

Participants were notified in the welcome letter they receive upon registering for the class, that completing the survey indicates consent to participant in the study. An injury waiver required by the health system was obtained by the second instructor's LLC prior to the first class and signed by participants. To ensure compliance with the health system's policies regarding PHI, these were collected and stored by the second instructor as they will contain the participants name. The instructor conducting this study did not see or have access to the injury waivers. The second instructor is a contracted employee of the health system.

Any participant was free to not participate in the quality study and still partake in the Tai Chi program. The class roster was a checklist form where participants can check a box next to their identifying number on the days they attend.

At the completion of the twelve weeks, participants were given 30 minutes to complete a second ABC scale questionnaire (see Appendix A). This questionnaire required them to remember and write their identifying number on the form. If the identifying number is forgotten, the participant will answer the three unique questions which the instructors can match to the answers from the first questionnaire.

Statistical analysis

It was expected that a 25% attrition rate would result in a reduction of the sample size over the course of the twelve weeks. The program's actual attrition rate of 20% resulting in twelve persons completing the course. Therefore, the assumptions for a t-test were not met and descriptive statistics are used to compare the pre and post-test scores. Inherent bias and self-selection were considered. Exposure to the Tai Chi exercise program is the interventional variable represented by a time; a pre-test before the intervention, and a post-test after the intervention. The pre-test and post-test score scores were compared using Windows Excel software. Only persons completing 18 or more of the 24 classes, 75% of the classes, were eligible to complete the post intervention survey.

In summary, the effectiveness and translation of this TCMBB program was evaluated by measuring the change in subjective fall risk measurement, class participation, and participant satisfaction (evaluation) with the program. Demographic data was also collected to evaluate generalizability of the program to other populations (American Psychological Association, 2010) and make predictions about program reach, sustainability, and opportunities for improvement.

Chapter IV

Findings

While falls continue to be the leading cause of injury for older people (Centers for Disease Control [CDC], 2015a), Tai Chi exercise has been shown to effectively reduce fall risk in this population (Gillespie et al., 2009). The findings of this small translational study describe the outcomes of implementing a Tai Chi Moving for Better Balance (TCMBB) program for older adult fall prevention within a healthcare system.

Class Attendance

Among the fifteen participants who completed pre-class survey, 80% (n=12) met the eligibility requirement for participation in at least at least 75% of the class sessions and completed the post class Activities-specific Balance Confidence (ABC) survey. Two women attended 96% of the classes with most of the participants attending 85-90% of the classes.

ABC scores

As shown in Table 3, the initial comparison of the mean ABC scores in the persons completing the course demonstrates an overall change of 7% from pre-Tai Chi to post-Tai Chi class, indicating an overall reduced fall risk. The three non-completers were less than age 70, otherwise there were only very small demographic differences between the completers and non-completers.

Table 3

Change in mean ABC Score Pre and Post Tai Chi Class, n = 12

Participant	Pre-Tai Chi	Post Tai Chi	Change	% Change
1	83	93	10	12%
2	97	100	3	3%

3	84	93	9	10%
4	99	100	1	1%
5	69	88	19	27%
6	96	96	0	0%
7	89	88	-1	-1%
9	95	72	-23	-24%
10	84	88	4	5%
13	68	91	23	34%
14	96	97	1	1%
15	67	97	30	45%
Total	86	92	6	7%

Of the 12 completers, 10 women showed positive change. Three of the women had substantial change – showing 45%, 34% and 27% improvement in their ABC scores. There were two outliers that showed negative change - this may have been the result of confusion when completing the post survey at the end of the last class. The last Tai Chi class was a few days before Christmas, which generated a lot of excited discussions about the holidays. Although thirty minutes to complete the questionnaire was provided, participants may have been in a hurry to leave for the holidays or distracted by the activity in the room. This author believes the ABC questionnaire may not have been completed correctly in the two outliers as there was no indication that any participant was not progressing in the class. As shown in Table 4, when the outliers are removed, the overall improvement in balance scores was 12%, indicating a greater overall reduced fall risk.

Table 4

Change in mean ABC Scores Pre and Post Tai Chi Class with Outliers Removed, n = 10

Participant	Pre-Tai Chi	Post Tai Chi	Change	% Change
1	83	93	10	12%
2	97	100	3	3%
3	84	93	9	10%
4	99	100	1	1%
5	69	88	19	27%
6	96	96	0	0%
10	84	88	4	5%
13	68	91	23	34%
14	96	97	1	1%
15	67	97	30	45%
Total	84	94	10	12%

Table 5 presents mean values for all 16 fall-related outcome questions that comprise the ABC scale. There were pre-post improvements in all but two of the questions, however, the self-reported confidence scores on several questions resulted in a 10% or higher improvement. These questions were as follows: How confident are you that you will not lose your balance or become unsteady when you...: ABC #2 'walk up or down stairs?': ABC # 6 'stand on a chair and reach for something?': ABC #15 'step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing?' and ABC#16 'walk outside on icy sidewalks?'

Table 5

Pre and Post ABC scores for older women participating in the Tai Chi exercise class

Measure	Pretest Score	Posttest Score	Change in Mean	% Change
Q1	92	98	6	6
Q2	78	89	11	12
Q3	89	95	6	6
Q4	94	100	6	8
Q5	81	88	7	8
Q6	73	82	9	11
Q7	94	100	6	6
Q8	96	98	3	2
Q9	94	96	2	2
Q10	94	98	4	4
Q11	87	94	7	7
Q12	91	94	3	3
Q13	85	90	5	6
Q14	85	90	5	6
Q15	74	82	8	10
Q16	61	72	11	15
Total Mean	86	92	6	7

Note. Q = question on the Activities Balance Confidence (ABC) questionnaire.

Mean score is the average of the 16 questions on the questionnaire.

Class Evaluations

After the program, eight participants completed course evaluations (see Appendix C). As shown in Figure 3, all eight of the participants (100 %) indicated they strongly agreed on the quality of the class on the class evaluation form. An important finding is that when asked to rate improvements and confidence in their balance, 100% of the participants strongly agreed on achieving improvements in their balance. Other elements of the course evaluation are also shown in Figure 3. Overall, no participant evaluated any question in the evaluation form below a neutral rating.

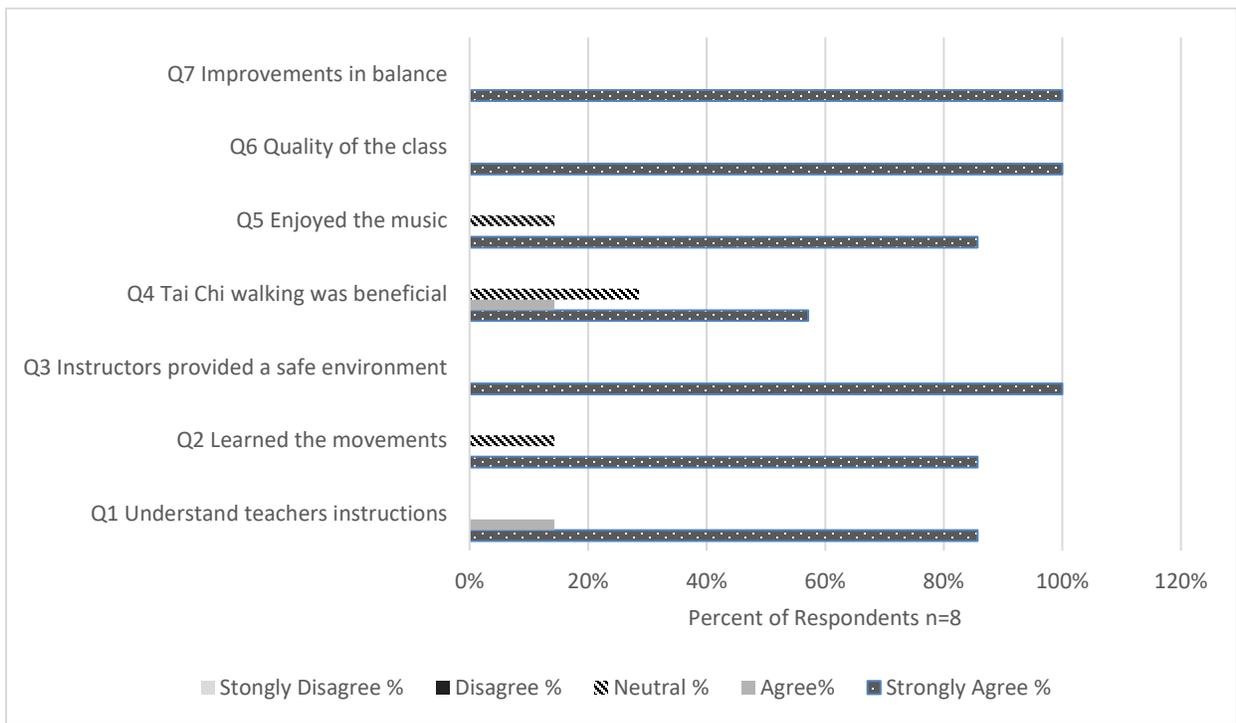


Figure 3. Summary of Tai Chi exercise class evaluations

The final question was an open-ended question where the participant was asked to provide additional feedback or recommendations to the instructors. The participants could also send the instructors a narrative about how this Tai Chi exercise benefited them. Three additional narrative responses, in addition to the narratives in the evaluations, were received. The

opportunity for narrative feedback was enthusiastically received by the participants, the responses of which are summarized in Table 6. In summary, participants reported an improved sense of well-being. They also appreciated the supportive environment, gained confidence in their balance, and enjoyed the relaxing and meditative quality of the class.

Table 6

Qualitative narrative responses from participants

-
1. The class has improved my balance and confidence (no falls since it began, when I was falling at least twice a month). I really like the meditative walking, the class members are very supportive, and fun. Every element of the class was important to me. Centering, positions, walking. All of it! This is far more affordable and better than the Balance Center for me.
 2. I so appreciated this class and the very engaged and enthusiastic instruction. The process was relaxing and positive each time which goes a long way after a stressful day. Thank you for your commitment to it and I'll look forward to continuing.
 3. I appreciated the gentle exercises that helped limber up my joints and strengthened the ankle that was giving me trouble the first week or two. Also, I very much appreciated the initial meditative activity (the name of which I don't remember).
 4. My balance improved considerable and I hope to continue learning and growing with more Tai Chi practice. This class was remarkable! Helen and Denise were so kind and helpful and tuned in to our needs as students. They were very professional and conveyed the seriousness and joy of Tai Chi.
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5. In the middle of the series, I was struggling a little but about 3 weeks from the end, it all came together. A single voice i.e. one person teaching the class is better. I felt I got mixed messages sometimes. There was one class taught by Denise and 2 by Helen that, I thought, were easier to follow. Overall, I found the class very helpful. My balance improved. When I started the meditative walking, I could barely lift my feet to keep my balance. By the end of the class it was much improved, and I could really lift my feet. Think you have to stick with it...after 24 classes it was the last 3 weeks where it all came together.
 6. I liked the times we didn't use music once in a while, as it seemed like everyone was concentrating and really being in the moment, but overall, I prefer to have music. It helps me with rhythm and flow. The question that wasn't asked on the survey before and after class was Do you have to sit down or lean on something to put your pants on? For me, I did before class, but after class I don't have to anymore! Also, one-legged balance postures in yoga are much easier, which is nice. I feel I can continue to work on balance in yoga with the Tai Chi practice layered on to my yoga practice.
 7. The class truly has helped me with my balance and over all equilibrium. Helen and Denise were very opened to our needs and suggestions. They truly had patience. They did well in showing positions. This is hard to put in words, but there were a few times I would have liked to have had them break down the positions more (step by step). I am so grateful I had the opportunity to have taken this class.
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8. The instructors also gave us information about the origins and framework of Tai Chi practice by sharing passages from books. We also received instructions on how to get into positions that reduce knee strain. + meditations, + warm-ups prior to getting into forms. The great relationship/friendship between the teachers/presenters set the tone for an understanding, acceptance, care, and also fun experience. I recall a session where something (that Helen said) struck Denise as funny, she couldn't stop laughing, and soon we were all laughing. As we got to know one another and had conversations prior to or departing class, we formed a supportive group. We became aware of life stressors/burdens other women were carrying. Women were caregivers to family members who were ill, women had extreme job stress, were adjusting to their lives as retirees or after adult children moved away, or they themselves moved. It was great that we had this time to put anxiety and sadness aside for that time period. The instruction to keep all joints loose, combined with the mental peace I was able to achieve contributed to a lightness of being that carried over into my evening.
9. Thank you for offering this class! I thoroughly enjoyed the experience. I feel that body awareness, particularly the position of my feet, and the practice of keeping my body upright and centered over my legs while keeping my joints loose has contributed to better balance. Other benefits have been
- The meditative quality of needing to focus on several things at once for an extended time period.
 - Working on flexibility of neck to ankles twice a week.
-

-
- A really warm, supportive community that all of us women formed!
That was unexpected.
 - I notice that intermittent time on one foot has increased my ability to balance on one foot/leg.
 - + de-stress after work day without drinking alcohol.
 - +great sense of well-being when leaving class.

10. Benefits of Tai Chi. I am able to hold the balancing postures in my yoga practice for much longer periods of time.

11. I feel more secure in my body and it's relation to space. I have a better sense of my personal boundaries.

12. When out walking, I was ready to cross the street when a car approached. My right foot was up in the air and my left foot was half on the edge of the curb, I stayed that position without wobbling for 3-4 seconds until the car had passed.

13. Overall, my general feeling of confidence has grown.

Discussion and Project Evaluation

The findings of this quality improvement project demonstrate the feasibility and successful translation of a 12-week TCMMB for older women within a large urban healthcare system within West Michigan as a means of improving indicators associated with fall risk. Community based Tai Chi training to improve older women's risk of falling was shown to be effective as evidenced by positive changes in the ABC scores while also impacting the personal growth of the participants.

The improvements in perceived balance, and therefore fall risk (Powell & Meyers, 1995), are consistent with those reported in the literature (Bubela et al., 2017; Gallant et al., 2017; Li et al., 2008;) in their community-based 12-week TCMBB programs. Although this study cannot demonstrate statistical significance of the improvements, it did demonstrate successful implementation with demonstrated improvements in perceptions of balance in addition to testimonial evidence of other personally acquired potentials (PAPs). PAPs are basically our adaptations and everything we learn, influencing our biological given potentials (BGPs) as they decline with age. Learning new skills and behaviors and having positive responses to new challenges, such as those reported in the class evaluations, represent personal growth and have the potential to further evolve in positive, health affirming ways as the body ages and balance declines. Learning new behaviors such as those in this Tai Chi exercise class is also an example of the adaptation process that may, in turn lead to more adaptation and personal growth. This is consistent with Complex Adaptive Systems (CAS) theory.

Although the increase in mean ABC scores represents a positive overall change and reduction in fall risk, statistical significance was not calculated because of the small sample size. The overall pre-class mean score was 86% and post-class mean was 92%, resulting in a 7% improvement in the overall mean score. Four of the participants experienced a more than a 10-point increase, four almost no change (-1 to 1-point change in pre-post class ABC), four some change (2-9-point change) and one scored 23 points lower after the program. Because the TCMBB program was designed for older adults (Li et al., 2005), it is interesting that two of three participants achieving the largest change were above the age of 70; one 70-75-year-old and one 75-80-year-old.

As discussed previously, a total ABC score of 80% denotes a high level of physical functioning, 50-80% indicates a moderate level, and less than 67% indicates risk for falling and is predictive of a future fall (LaJoie, 2004). Only one participant had a pre-class score of 67. Remarkably, this 70-75-year-old scored 97% on the post-class questionnaire resulting in a 45% change in the ABC score.

Feasibility and Translation

The program was well received by the women who participated in the study, some of whom were still working full time and noted the class was a good way to relax after work while improving their sense of wellbeing. Feasibility was further demonstrated by the low cost of program implementation and support the literature that Tia Chi is a low-cost exercise activity (Li et al., 2008). In this project, the total cost of program implementation was \$1,744.00. When broken down, the cost of the program was \$145 per participant for the entire 12-week session, or \$6.05 per participant for each class. These program expenditures, however, did not include the researcher instructor time, facility overhead, and indirect administrative overhead. A larger class size would improve the cost effectiveness of this program by reducing the cost per participant. In the experience of the instructors, twenty participants would be optimal in this setting.

Other factors that contributed to feasibility included: Easily accessible classroom spaces in building adjoining the main hospital; availability of large classrooms that did not require modifications; no additional equipment other than a speaker for music was required; and an adjoining parking ramp with access directly from the ramp to the classroom. Free, protected ramp parking was appreciated, especially as our program was implemented during the late fall months.

Barriers to reaching the optimal sample size included the short amount of time the class was marketed and the marketing strategy itself. Future use of social media, in addition to marketing adequately in advance of the class, and word of mouth are expected to increase class size.

Adoption and Reach

Evaluation of adoption and reach were achieved by measuring attendance, satisfaction with the class, and evaluation of the demographic information. Mean attendance for completers was 85% (n = 12) of class sessions. Several participants had difficulty attending the required 18 classes in order to meet the 75% requirement to be included in the study but expressed the desire to be included. The instructors chose to hold one makeup session, which four participants attended, bolstering their attendance. Finally, the class evaluation results showed 100% (n = 12) of the completers strongly agreed on the quality of the class and improvements or confidence in balance.

During class conversations, many had expressed interest and excitement to take the class. Although adoption of the program was good, reach beyond this demographic group of active, well-educated, white women, was not achieved and should be an important component of future translational projects.

Widespread dissemination (reach) of TCMBB or similar fall prevention programs have several barriers related to the research to practice gap (Li et al., 2017). The adoption of evidence-based fall prevention programs has been slow; however, it appears to be gaining momentum as hospital systems and ACOs implement population health strategies aimed at reducing costs and improving quality care (Bresnick, 2017). Some barriers, such as evidence to support the return on investment (ROI) and translation of TCMBB programs, are diminishing with growing

evidence in recent research studies. Marketing, referrals, location of classes, and other strategies should be studied to improve reach into targeted diverse populations within communities of older adults at risk for falls.

A potential barrier included the availability of qualified Tai Chi instructors. The instructors in this study were well trained with dual certification, many hours of practice and experience teaching a prior program to older adults. They did not, however, have extensive Tai Chi experience. Finding qualified instructors with extensive experience or even moderately extensive experience, such as those in this study can be a barrier to widespread implementation, however, Gallant et al. (2017) showed that the 12-week program can be feasibly implemented by novice instructors. This author agrees with Gallant et al. (2017) that an instructor pool could be built by having a mentorship program where novice instructors work with more experienced instructors.

It is interesting to note that several of the participants in this study were middle-aged and still working full time, indicating the program may appeal to a wider audience. Zacharia, Taylor, Hofford, Brittain, & Branscum (2015) found that healthy middle-aged women with no physical limitations, participating in a short 8-week Tai Chi program had significant improvements in their physical functional. after performance supporting the value of investing in functional performance and reserve to slow age-related declines. Zacharia et al. (2015) postulate that this finding supports efforts to improve physical functioning during middle age may provide a physical reserve, such as better balance and physical functional ability, as they enter older age. Middle age participants may find Tai Chi an exercise that encourages participation and adherence because it is low intensity yet challenging especially when the participants feel supported, safe, and a sense of well-being as the participants in this study reported.

Class Evaluations

Many of the participants reported anecdotal testimonies about their perceived improved balance, aborted falls, improved functional ability in activities of daily living, and sense of well-being. Several participants described improvement in the inability to perform simple tasks such as, lifting a foot while walking and putting on their pants, prior to the class and were now able to perform these functions. Most described enjoying the meditative aspects of the class and felt this contributed to their sense of well-being and de-stressing. Specifically, the Qi-Gong warm-ups and breathing meditation centering done at the beginning of class were mentioned.

Meditative Tai Chi walking was added as the cooldown at the end of every class and evaluated on the class satisfaction survey. This is very slow walking where the participant observes their movements and focuses on foot placement, weight shifting while keeping knees loose. Several of the participants commented on the meditative walking in the context of improving their balance. Four strongly agreed the tai chi walking was beneficial, 2 agreed, and 1 was neutral. None of the participants indicated they did not agree it was beneficial. Future studies could examine the effectiveness and appropriateness of Tai Chi walking as a cooldown exercise in the TCMBB program.

Limitations

The generalizability of our findings is limited, as this constituted a quality improvement project and lacked the rigor of a more systematic study. Furthermore, only participants interested in Tai Chi within a small geographic area in West Michigan participated in the class. The small sample size, all white and well-educated, also limited generalizability. Finally, without a comparison control group, the quasi-experimental study design of this study limited the identification of factors influencing improvement that are unrelated to the Tai Chi exercise.

Future translational projects should aim to improve generalizability with greater rigor, larger sample sizes, and more diverse populations of older adults at risk for falls. A non-exercise control group could generate more comparison data however, clear evidence for the effectiveness of Tai Chi exercise under research conditions already exists (Li et al., 2017). Additional research is needed on the translation of the program in diverse practice settings using public health models to evaluate the translation (Li et al., 2017). Future studies could include: evaluation of classes using a larger class size, up to 25 participants with two instructors, to improve cost effectiveness; evaluation of effectiveness using different instructors: study and implement a provider referral system to the class; and evaluation of impact with community funded classes in diverse settings.

This project demonstrates successful translation and feasibility of a 12-week Tai Chi exercise program with results that are consistent with other research findings. Furthermore, sustainability may be demonstrated by the continued scheduling of the classes within the West Michigan health system.

Significance and Strengths

This project provided further evidence for the effectiveness of an evidence-based community Tai Chi fall prevention program for older adults. The primary objective of this translational quality project, the implementation of the TCMBB program and its effectiveness in reducing perceived fall risk for older women, as measured by the ABC scale, was met.

Ultimately, reducing the number of older person falls could have a substantial impact on the personal and economic burdens of falls. Falls remain the leading cause of fatal and nonfatal injuries in people aged 65 and older threatening the health of older people and their ability to remain independent (CDC, 2015a). Furthermore, falls in this population are associated with

significant morbidity and mortality (Bhattacharya, Maung, Schuster, & Davis, 2016). Increasing age further increases the risk of falling and the morbidity and mortality associated with a fall.

Every fall averted by an intervention also has the potential for cost savings. The reduction in fall risk shown in this project has the potential to reduce the economic costs of medically treated fall injuries among older adults. These costs are substantial with the average hospital cost for a fall related admission now reaching over \$30,000 (Burns, 2018).

Furthermore, translation and dissemination of the scientifically validated TCMBB fall prevention program was successful in this study setting, thus narrowing the research to practice gap. Reducing perceived fall risk by implementing this quality project resulted in a sustainable, cost effective, and repeatable fall prevention program within the community setting of a healthcare system.

Quality and Fidelity

The mechanisms used to adhere to quality standards for this project included methods to assure the fidelity of the intervention and competency of the instructors. Methods to assure quality included design of the Tai Chi program, the instructor's training, certifications, experience, and the procedures to ensure data safety.

Quality.

Strengths supporting the quality of this study included (a) the design of the study. Quasi-experimental (QE) designs are considered strong reliable designs, (b) the survey used (ABC questionnaire) to collect information is a reliable and validated instrument, (c) the program implemented is an evidence-based TCMBB course, (d) the instructors competence as demonstrated by training, certifications, and experience, (e) procedures used to ensure participant data safety, (f) the application of the highest level of statistical analysis considering inherent bias

and self-selection, and (g) guidance from a theoretical perspective provided by the Meikirch model and complex adaptive systems theory.

Limitations or threats to this study's validity included (a) small sample size, limiting generalizability of the study findings, (b) selection bias of the participants, (c) post-survey testing influence from the pre-test history, (d) potential participant attrition, (e) inability to evaluate long-term maintenance of outcomes, and (f) potential experimenter effect and power of suggestion (first day introductions). Finally, this project was designed as quality study, focusing on a specific area for improvement in a defined community, and is therefore, not generalizable.

Instructors.

Both instructors teaching this Tai Chi program have Qigong and Tai Chi training obtained at various workshops and private lessons. They have completed training and received two certifications in Tai Chi instruction. Certification consisted of eight hours performance of the Centers for Disease Control's (CDC) TCMBB exercises, eight hours assessing performance of CDC's TCMBB exercises, and instructor training in Beginning Tai Chi. One instructor is also a certified E-RYT-500 hour, Kripalu Yoga Instructor and the other, this study's author, a masters prepared nurse. At the time of this projects' implementation, the instructors' experience includes twelve months of Tai Chi training and three months teaching TCMBB to older adults in the community.

Data integrity.

Data collection took place on-site prior to the first class and after the last class. The ABC questionnaire with the demographic data and the attendance roster was collected by the instructor/project manager and securely stored in a personal filing cabinet accessible only to the project manager. Data will be stored for three years. No PHI was collected on these forms from

the participants. No personal identification was on the forms. Each participant completed a form with a unique identifying number rather than their name. This number was used to match the pre-tests, post-tests, and attendance roster.

Fidelity.

Fidelity of the Tai Chi intervention in this project, was the extent to which the program followed the original Tai Chi for Therapy and TCMBB programs. The exercises were taught as prescribed by the Tai Chi for Therapy course and TCMBB. Reminders of the principle elements of posture with a focus on balance were given frequently during practice. For example, reminders on how to properly shift weight, lower center of gravity with relaxation and soft knees, and to use Tai Chi breathing and posture. Instructors remained true to the design of the program. Preparation for each class included development of detailed agendas using the Tai Chi for Therapy core schedule as the framework (Sacharko,2018). The instructors were always available for a few minutes after class to answer questions.

Ethics

This project was a quality improvement project. Lynn et al. (2007) state that quality improvement is an intrinsic part of normal health care operations with ethical oversight as part of an enhanced accountability system for professional responsibility and supervision of clinical care within a healthcare organization. Quality improvement was defined as “systematic, data-guided activities designed to bring about immediate improvements in health care delivery in particular settings and concluded that QI is an intrinsic part of normal health care operations” (Lyn, et al., 2007, p.1).

The health system where this project was conducted adheres to Hastings Center guidelines as described in A Spectrum Health IRB Guidance Document (Spectrum Health,

2002). This quality improvement project ensured compliance with the guidelines. Specifically, participants were told why the activities they engaged in are important to their health. This was incorporated into the program introduction first day of class. Participants were encouraged to seek additional information from the instructors should they desire to do so. Assurances of confidentiality were provided.

To assure compliance with the standards for protection of human rights, approval for this project was obtained from FSU Institutional Review Board and implied consent was obtained from the participants. Finally, both instructors completed the CITI Research Ethics and Compliance Training Program, as required by Ferris State University. Determination as a quality improvement study was sought and granted by the health system's Institutional Review Board. As required by the institution, permissions from the Women's Health executive was obtained before the project begins. This permission request is in process as is a separate request for foundation funding of the project.

Perfect spot for the quality & fidelity & ethics section here.

Timeframe Evaluation

Overall, this project required twelve months to complete, six months to plan the project and train the instructors, three months to implement the TCMBB class, and three months to analyze the data and write the project final paper.

Dissemination and Sustainability

Dissemination of the project findings is a critical step to impacting further translation of Tai Chi exercise for fall prevention in the community. A final public presentation and oral defense will be scheduled with the Ferris State University (FSU) School of Nursing in June 2019. Invitees to the public presentation will include the FSU nursing faculty and students,

project content experts, professional colleagues interested or involved in the project. The information will be presented using a PowerPoint summary of the project, its findings, and the plan for sustainability.

An executive summary of the project was presented to the leaders and stakeholders of the organization where the project was implemented. This group of invitees was smaller and included the physician leader and research assistant. As stakeholders in successful dissemination of this project, the Tai Chi class participants will also be offered the opportunity to review the executive summary.

Another venue for dissemination is the State of Michigan's (SOM) annual trauma or injury prevention conference and the education session of the Michigan Trauma Coalition (MTC) meeting. Although I have made a request to present a poster at the SOM October 2019 conference it is uncertain at this time whether there will be an opportunity for any poster presentations at this conference due to space limitations.

Publication in one of the injury prevention, emergency nursing, women's health, or public health nursing journals is being thoughtfully considered. Publication possibilities need further research and consultation with the FSU faculty advisor.

While the literature supports the translation of TCMBB for older adults in the community setting, no studies could be found analyzing the impact of home practice guides or tools such as the home practice YouTube video prepared for this project. However, evidence shows that Tai Chi program effectiveness is enhanced when the participants practice one hour per week at home in addition to attending a twice a week class (Sacharko, 2018). Home practice between classes was encouraged but many participants had expressed the desire for an instructional video to assist in this practice. During the study, the participants were given the opportunity to video the

instructors performing the entire 8-form sequence to use at home. Subsequently, a YouTube video, produced with the assistance of the Ferris State University media department, was produced. This video contains the instructors' choreographing the entire flow and complete verbal instructions for each form. An assumption supporting the production of this video is that engagement and motivation of the participants will be enhanced when practicing with their instructors, thereby enhancing the effectiveness of the class.

Sustainability of the progress made during the study PSDA cycle and dissemination of the results as the next cycle is planned is an important component of this project. Each iterative cycle of the Plan-Do-Study-Act (PDSA) for subsequent project implementations should result in making continuous improvements more successful (Reed & Card, 2016). The opportunity to repeat and improve upon best practices from this project have the potential to reduce the number of injurious falls older women experience and improve their quality of life. Subsequent to the completion of this project, additional TCMBB classes have been taught at the sponsoring health system, and future classes have been scheduled.

A summary of the project results, effectiveness of Tai Chi for health, and a Tai Chi flow were presented at a 2019 women's health symposium (<https://www.facebook.com/spectrumhealth/videos/425277738296272/?t=484>). The health system, and its physician sponsor to this project, are also interested in integrating the TCMBB class into healthy aging offerings within the Women's Health service line. To enhance reach, beyond the health system's usual marketing, the program has been listed on the State of Michigan, Region 6 Injury Prevention Resource Guide. This resource guide is used by healthcare professions involved in community injury prevention activities as a reference for patient or client referrals to an appropriate injury prevention program. Sustainability of the program will be

enhanced by continued application of the PDSA model with measurement of program outcomes, such as the class evaluations.

Conclusion

The findings of this small translational project support the feasibility and efficacy of implementing a Tai Chi exercise program for older adults in a large urban health system. A quasi-experimental design used to measure the effect of a TCMBB class in individual's perceived confidence in performing 16 functional tasks as measured by the ABC scale. The ABC questionnaire were measured at baseline and at 12-weeks following the twice a week Tai Chi intervention. An overall improvement of 7% in the ABC scores which may reduce the fall risk in this population. Class attendance, participant satisfaction with the program, and demographic data was compared to the ABC data and used to further analyze the outcomes.

Reduction of fall risk in populations is an important area of population health science. Injurious falls are the most prevalent cause of hospitalizations in older adults resulting in a significant burden to North Americans – both financial and personal (Center Disease Control, 2015). Using complex adaptive systems theory and the Meikirch model as the theoretical underpinning for this project, individual fall risk was contextualized within a system's theory framework to evaluate the translation of the program at the community level- in this study a large urban health system. As individual fall risk is reduced within a community, the number of injurious falls may also be reduced, thereby affecting embedded community systems such as a reduction in hospital admissions, healthcare costs, and burdens to families caring for injured patients.

These results add to the growing body of evidence supporting Tai Chi as an effective, low-cost, community-based fall prevention modality. They also support the CDC's endorsement

of Tai Chi and TCMBB specifically, as an evidence-based effective fall prevention program (CDC, 2015b). Although this study had a small sample size, making the study non-generalizable, the outcomes demonstrate improved perceived balance, lowering fall risk, and good adoption. This program may also appeal to middle-age women as it may positively influence future health and fall risk as they enter older age and, anecdotally it may contribute to the participants' sense of well-being.

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Appendix A

Marketing Flier

Tai Chi Exercise Classes With Helen Berghoef and Denise Karsen

October 2, through December 20, 2018



Classes held in Rooms 120/121, 221 Michigan Medical Building, Butterworth Hospital (across from
the Meijer Heart Center)

Tuesdays & Thursdays at 6:30 P.M.

**To Register: Call 616-267-8052**

Tai Chi is an ancient practice that helps improve balance and reduce stress. Tai chi has been found to enhance stability and decrease fall risk in many scientific studies. Often referred to as a form of “moving meditation”, Tai Chi is a mind-body technique that involves carrying out a series of slow, gentle movements combined with deep breathing and meditation.

If you are a woman 55 or older, we welcome your participation in this class and a study, if you choose. For the study, you will be asked to complete two surveys. You are able to participate in the class without participating in the study. The study information will be sent to you with your welcome letter upon registering for the class.

This class and study are for women age 55 and older.

Appendix B

Welcome letter to participants

Welcome to the Tai Chi Exercise class at Spectrum Health,

Denise Karsen and I, Helen Berghoef, are excited to bring this Tai Chi exercise class to you.

The program we teach is called Tai Chi: Moving for Better Balance. We are both certified Tai Chi instructors. This program includes eight Tai Chi forms or exercises designed with the goal of improving balance, increasing mobility, and reducing falls. The movements are a set of 8 simple, continuous, rhythmic exercises.

This program is for women aged 55 and older. No prior experience is needed to participate. We ask that you wear loose, comfortable clothing, and shoes.

Classes will be held at 221 Michigan Street in the Medical Building, Butterworth Hospital (across from the Meijer Heart Center), Rooms 120/121, on the 1st floor.

Tuesdays 6:30 pm – 7:30 pm, and Thursdays 6:30 pm – 7:30 pm, October 2 through December 20, 2018.

Free parking is available in Parking Lot #7. Parking passes will be available. • The class is 12-weeks and meets two times a week.

To register please call 616-267-8052. Registration required as class size is limited.

This program is sponsored by the generous support of the Spectrum Health Foundation.

For questions about the Tai Chi class, please contact Denise Karsen at dkarsen@gmail.com or

Helen Berghoef at helen.berghoef@gmail.com

As part of this class, you are invited to participate in Helen's study "Implementation of a Tai Chi Program for Community-Dwelling Older Women". I am interested in finding out if your feelings about balance change after taking this 12-week Tai Chi exercise class.

Your participation in this study will require the completion of a questionnaire at the beginning and at the end of the program. This should take approximately 10 minutes of your time. We ask that you come 30 minutes early to the first class where I can answer any questions you may have about the study and to complete the questionnaire. Your participation will be anonymous, and you will not be contacted again in the future. You will not be paid for being in this study and there is no cost to you for participating in this Tai Class. This survey involves minimal risk to you. The benefits, however, may impact society by helping increase knowledge about Tai Chi exercise for fall prevention in women.

You do not have to be in this study to participate in this Tai Chi exercise class. You do not have to answer any question that you do not want to answer for any reason, and you may drop out at any time. You may continue the Tai Chi class even if you do not stay in the study.

The completion of the questionnaire on the first day of class implies your consent to participate in the study. I will be available to answer any questions you have about the study at the first class or you may email Dr. Bitner at diana.bitner@spectrumhealth.org.

Sincerely, Helen Berghoef, RN, MSN

Doctor of Nursing Student at Ferris State University

Appendix C

Tools Used for Data Collection

The Activities-specific Balance Confidence (ABC) Scale

Identification Number: _____ (Please remember this number) Date: _____

Should you forget your number, we will ask you provide the following information.

1. What is your mother’s maiden name? _____
2. What is the make (manufacturer) of your first car? _____
3. What is the name of your first pet? _____

PLEASE PROVIDE THE FOLLOWING INFORMATION

1. 1.Your age range. Check the appropriate box	2. 2. Your race or ethnicity? Check the appropriate box
<input type="checkbox"/> 55-59	<input type="checkbox"/> American Indian or Native Alaskan
<input type="checkbox"/> 60-64	<input type="checkbox"/> Asian
<input type="checkbox"/> 65-69	<input type="checkbox"/> Black or African American
<input type="checkbox"/> 70-74	<input type="checkbox"/> Hispanic or Latino
<input type="checkbox"/> 75-79	<input type="checkbox"/> Native Hawaiian or other Pacific Islander
<input type="checkbox"/> 80-85	<input type="checkbox"/> White

3. Have you ever done Tai Chi Before? If yes, _____

4. How much do you exercise?

- Not at all, or very little
- 30 – 60 minutes per week
- 1 – 2 hours per week

2 – 3 hours per week

More than 3 hours per week

5. Have you fallen after age 55? If yes, how many times? _____ Did the fall result in a broken bone? _____

6. Please check your education level

<input type="checkbox"/> Some high school, no diploma	<input type="checkbox"/> Trade/technical/vocational training	<input type="checkbox"/> Master’s degree
<input type="checkbox"/> High school graduate, diploma or the equivalent (for example: GED)	<input type="checkbox"/> Associate degree	<input type="checkbox"/> Doctorate or Ph.D.
<input type="checkbox"/> Some college credit, no degree	<input type="checkbox"/> Bachelor’s degree	

Identification Number: _____ (Please remember this number) Date: _____

The Activities-specific Balance Confidence (ABC) Scale

Instructions to Participants: For each of the following activities, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady from choosing one of the percentage points on the scale from 0% to 100%. If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports.

0% 10 20 30 40 50 60 70 80 90 100%

No Confidence

Completely Confident

How confident are you that you will not lose your balance or become unsteady when you...

1. ...walk around the house? ___%
2. ...walk up or down stairs? ___%
3. ...bend over and pick up a slipper from the front of a closet floor? _%
4. ...reach for a small can off a shelf at eye level? _%
5. ...stand on your tip toes and reach for something above your head? _%
6. ...stand on a chair and reach for something? ___%
7. ...sweep the floor? ___%
8. ...walk outside the house to a car parked in the driveway? _%
9. ...get into or out of a car? ___%

10. ...walk across a parking lot to the mall? __%
11. ...walk up or down a ramp? ___%
12. ...walk in a crowded mall where people rapidly walk past you?_%
13. ...are bumped into by people as you walk through the mall?_%
14. ...step onto or off of an escalator while you are holding onto a railing?_%
15. ...step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing? ___%
16. ...walk outside on icy sidewalks? __%

*Powell LE & Myers AM. The Activities-specific Balance Confidence (ABC) Scale. Journal of Gerontology Med Sci 1995; 50(1):M28-34.

Total ABC Score: _____ Scoring: _____ / 16 = Total ABC Score

_____ % of self confidence

Tai Chi Class Evaluation Form

Instructions: Please check the circle on the scale below each question to indicate your response.

1. Did you understand the teachers' instructions?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. Do you feel you successfully learned the majority of movements (exercises) in this class?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. Do you feel the instructors provided a safe environment to practice the exercises (for example, you were able to use a chair when needed or sit at any time, the instructors did not push you beyond what was comfortable for you)?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. Was the closing Tai Chi meditative walking beneficial?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. I enjoyed the music during the class.

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. Overall, how would you evaluate the quality of the class?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. Overall, how would you evaluate improvements or confidence in your balance?

————— ————— ————— —————

Strongly Agree Agree Neutral Disagree Strongly Disagree

8. Do you have any additional feedback or recommendations for us?