

THE RELATIONSHIP BETWEEN LEVELS OF PARTICIPATION IN YOGA AND
BALANCE MEASURES OF OLDER ADULTS

By

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Abstract: The purpose of this study was to examine the relationship between levels of yoga participation (i.e., overall lifetime engagement and the number of sessions attended in the past 30 days) and balance measures of older adults as measured by (a) the Activities-specific Balance Confidence (ABC) scale, and (b) the Multi-Directional Reach Test (MDRT). These two questionnaires along with a short demographic survey were administered to 52 participants, aged 55 years and above, who participated in yoga at one of the five identified agencies. Each participant was measured once at the completion of a yoga session. Linear regressions were utilized to determine whether the two yoga variables significantly predicted performance on the ABC Scale and MDRT. It was demonstrated that no significant relationships between the scores on the ABC scale and the two yoga participation variables. Regression results indicated that overall lifetime engagement in yoga and number of sessions attended in the past 30 days significantly predicted ($R^2 = .11$, $p = .03$) the forward reach measure on the MDRT. Participation in yoga was not significantly related to the backward reach, left lateral reach, or right lateral reach of the MDRT. Among yoga participants, relationships between balance and yoga

participation were generally low; however, the significant relationship between the forward reach measure and yoga participation suggests that yoga has some merit for use as an alternative therapy intervention.

Keywords: older adult, physical activity, fear of falling, balance, yoga

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Introduction

In the United States, the population of older adults is growing dramatically (Chen, Tseng, Ting, & Huang, 2007; Close, Lord, Menz, & Sherrington, 2005), and the World Health Organization (WHO) projects that two billion people worldwide will be aged 60 years and older by 2050 (WHO, 2012a). Many older adults do not achieve the recommended amount of physical activity and exercise, which increases the risk of various health issues (Stevens et al., 2014; Taylor, 2014; U.S. Department of Health and Human Services, 2008; Yorston, Hons, Kolt, & Rosenkranz, 2012). Even though there are many health concerns for older adults associated with the normal aging process and the lack of physical activity, falling is considered one of the major health risks to this population and the primary cause of injury (Centers for Disease Control and Prevention, 2013).

The Centers for Disease Control and Prevention (CDC) reported that the number of older adults hospitalized for fall-related injuries is five times greater than hospitalizations for any other injury. On average, a fall-related hospitalization costs \$34,294, making fall injuries one of the top 20 most costly medical conditions. Additionally, the total direct medical cost for fall injuries is projected to reach \$67.7 billion by 2020 (CDC, 2014a).

Every year, approximately 30% of independently living older adults will experience at least one unexpected fall (Arnold & Faulkner, 2007). Bloch et al. (2009) reported that nearly 40% of older adults who experience a fall are unable to get back up independently. Furthermore, individuals who experience a fall are about three times more

likely than non-fallers to experience another fall within the same year (Hakim, Kotroba, Cours, Teel, & Leininger, 2010).

After a fall, older adults are especially prone to developing a fear of falling (FoF), which can be just as harmful as the actual fall itself. FoF was reported in 40-73% of older adults who experienced a previous fall and 20-46% of older adults who have never fallen (Schmid, Van Puymbroeck, & Koceja, 2010), and resulted in reduced execution of particular functional balance tasks (Huang, Chi, & Hu, 2013). Huang et al. (2013) stated that FoF may result in more falls, depression, reduced ability to execute activities of daily living (ADL's) and increased limitations of physical activity.

Researchers have also identified that impaired balance and decreased strength in the lower extremities are significant risk factors in the reduction of physical functioning and occurrence of falls in older adults (Ceceli, Gökoğlu, Köybaşı, Çiçek, & Yorgancıoğlu, 2009; Granacher, Gollhofer, Hortobágyi, Kressig, & Muehlbauer, 2013). Often, impaired balance and decreased strength have been corrected with resistance training, however, resistance training did not result in improvements in functional tasks, balance, ADL's and reduced fall rates in these studies (Granacher et al., 2013). Howe, Rochester, Neil, Skelton, and Ballinger (2012) identified exercise interventions focusing on balance training as the most effective technique in reducing falls in older adults.

Research has demonstrated an association between participation in yoga and balance measurements of older adults and reveals that yoga may be an appropriate intervention for older adults to improve balance and reduce the likelihood of experiencing a fall (Hakim et al., 2010; Morris, 2008; Patel, Newstead, & Ferrer, 2012; Schmid et al., 2010; Tiedemann, O'Rourke, Sesto, & Sherrington, 2013). In the United States,

physicians referred 14 million people (6.1% of the population) to participate in yoga, as a therapeutic intervention (Roland, Jakobi, & Jones, 2011), making yoga one of the top 10 commonly used alternative therapies (Zettergren, Lubeski, & Viverito, 2011).

The following section offers a review of background literature as it relates to the role of physical activity for older adults, the issues related to the fear of falling, and the role of balance for the older adult population. Theoretical foundations are presented to support the use of yoga as a therapeutic intervention. In addition, yoga as an intervention is introduced and the results of a cross-sectional study of older adult yoga participants is presented. Conclusions and recommendations for recreational therapy practice are offered.

Background

Physical Activity & the Older Adult

The World Health Organization (WHO) defines physical activity as “any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, traveling and engaging in recreational pursuits” (WHO, 2014, para. 1). Despite the numerous known benefits of exercise, physical activity rates are very low for individuals over the age of 50 years. The U.S. Department of Health and Human Services (2008) reported that more than 60% of adults 50 years and older in the United States do not engage in the recommended amount of physical activity. Physical inactivity can lead to declines in muscle strength, muscle mass, endurance, balance, and cognitive performance and impacts an individual’s overall functional independence (Allison, Painter, Emory, Whitehurst, & Raby, 2013; Hornyak et al., 2013; Taylor, 2014; WHO, 2010). The most

important intervention in improving physical functioning in the older adult population is to increase physical activity levels (Paterson, Jones, & Rice, 2007; Yorston, Kolt, & Rosenkranz, 2012). Physical activity may delay functional limitations and slow the progression of functional decline for older adults with and without disabilities (Paterson, Jones, & Rice, 2007; Tak, Kuiper, Chorus, & Hopman-Rock, 2013; Taylor, 2014).

Falls & Fear of Falling (FoF)

Approximately 424,000 individuals die from fall-related injuries every year, making falls the second leading cause of accidental deaths worldwide (WHO, 2012b). One in three adults aged 65 years and above will experience a fall each year (Arnold & Faulkner, 2007; WHO, 2007). The occurrence of falls is significantly higher (1.5 times) for older adult women than older adult men (Close et al., 2005).

After a fall, older adults are especially prone to developing a fear of falling (FoF), which can be just as harmful as the actual fall. Numerous negative consequences for older adults have been linked to FoF including decreases in health status and restrictions in activity participation (Allison et al., 2013; Huang et al., 2013; Jung, 2008). Restriction in activity participation, based on FoF is more prevalent in inactive older adult women (Allison et al., 2013). Older adults who restrict their level of participation in activities often have more muscle atrophy and poorer balance, which consequently can lead to future falls (Allison et al., 2013; Huang et al., 2013; Jung, 2008). DiBrezza, Shadden, Raybon, and Powers (2005) stated that physical activity is one preventative measure that can help reduce or prevent falls in older adults.

Balance

Seventy-five percent of individuals over age 70 years have balance impairments (Dillon, Gu, Hoffman, & Ko, 2010). Balance, as defined by Shumway-Cook and Woollacott (2007), is the ability to maintain the body's center of gravity over the base of support and is essential in successful performance in ADL's, recreational pursuits, and fall avoidance in older adults. Newton (2001) states that the ability to safely and confidently execute activities requires an individual to produce appropriate motor techniques when stationary or while in motion (Newton, 2001). When an individual's center of gravity moves out of line with his or her base of support, it exceeds his or her limits of stability for the performed task. If an appropriate motor strategy is not performed to realign the center of gravity with the base of support, the individual may lose his or her balance and/or fall (Newton, 2001). A large and growing body of literature has emphasized the importance of physical exercise programs on balance improvements in older adults. Exercise that gets older adults on their feet and incorporates balance training has been identified as the best approach to reducing risks of falls in older adults (Howe et al., 2012; Seco et al., 2013; Skalko, Sauter, Burgess, & Loy, 2013). Research suggested that older adults participating in Pilates, tai chi, and/or yoga have positive improvements in their performance of functional balance tasks and reduce their chances of experiencing falls (Granacher et al., 2013; Hakim et al., 2010).

Yoga

Yoga originates from the Sanskrit term *yuj* meaning, "to join", and signifies the integration of the mind and body in a complete union (Hayes & Chase, 2010; Roland et al., 2011). In the United States, approximately 86% of health and fitness clubs offer yoga

classes (Cowen & Adams, 2007). In the most current “Yoga in America” survey (2012), it is reported that 20.4 million people practice yoga, which is a 29% increase from 2008. Macy (2008) reported that individuals aged 55 years and above represent nearly 18.5% of yoga users. Approximately half (49.4%) of older adults practicing yoga testified to using it as a way of improving their overall health (Hayes & Chase, 2010). Yoga has been associated with positive improvements in many health outcomes including: cardiovascular functioning (Lipton, 2008), hypertension (Hayes & Chase, 2010; Raub, 2002), pain management (Chen et al., 2007; Patel, Akkihebbalu, Espinoza, & Chiodo, 2011; Raub, 2002), anxiety (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Lipton, 2008), asthma (Hayes & Chase, 2010; Raub, 2002), diabetes (Raub, 2002), mood (Raub, 2002), lower back pain (Hayes & Chase, 2010; Lipton, 2008), gait and mobility (Patel et al., 2011), strength (Hayes & Chase, 2010; Taylor, 2001; VanPuymbroeck & Hsieh, 2010) and flexibility (Chen et al., 2007; Ross & Thomas, 2010).

Additionally, research has noted an association between yoga and balance measures of older adults (Hakim et al., 2010; Morris, 2008; Patel et al., 2012; Schmid et al., 2010; Tiedemann et al., 2013). Current literature suggests that yoga may be an effective alternative therapeutic intervention to improve balance and prevent falls in older adults. Following a systematic review of 18 yoga studies on physical functioning, Patel et al. (2012) stated, “yoga may be superior to aerobic exercise interventions to improve self-rated physical health status...” (p. 913). Tiedemann et al. (2013) conducted a blind and randomized controlled trial on 54 older adults who were previously not active in yoga or tai chi. They found a significant improvement in standing balance and the one-legged

stand with eyes closed, after 12 weeks but only in their treatment group that participated in yoga.

Other studies have demonstrated that participation in yoga results in improved balance measures for older adults. Morris (2008) examined the effects of yoga on 18 females and concluded, “with the largest percentage of fall prevention owed to postural control to move around in the environment, yoga may be more effective at decreasing fall risk” (p. 83). Schmid et al. (2010) conducted a yoga program to determine whether FoF and balance would improve in 14 older adults who all reported a FoF. They found a modest, non-significant decrease (6%) in FoF. However, they did report a significant increase in static balance between baseline and post-intervention. Schmid et al. (2010) conclude that yoga “is a plausible intervention to positively impact both FoF and balance in older adults” (p. 580). In a study by Hakim et al. (2010), older adults participating in 8 weeks of yoga demonstrated substantial improvements compared to the non-exercisers on both lateral reaches of the MDRT (i.e., left and right lateral). Additionally, the yoga group exhibited the highest scores on the ABC scale, indicating a reduced FoF not observed in the tai chi or non-exercise group. Hakim et al. (2010) concluded that older adults participating in tai chi or yoga demonstrate better balance functioning than those not participating in structured exercise.

Current research supports improvements in balance and reduced falls for older adults participating in yoga. However, most studies do not focus on the relationship between degree of participation in yoga and physical health outcomes. Thus, more research needs to be conducted in order to determine if a relationship exists between the

level of participation in yoga and functional outcomes, specifically to increase balance and prevent falls for older adults.

Theoretical Foundations for Yoga as an Intervention Strategy

Motor learning theory describes the process of enhancing the individual's ability to learn, recall, and perform new motor skills. In yoga, motor recall is enhanced while practicing poses (asanas) and motor sequences through verbal instructions, visual demonstrations, and knowledge of results (KR) provided by the instructor. Yoga is theorized to, physically and emotionally, create balance by using asanas combined with breathing techniques (Feuerstein, 2000).

The Social Cognitive Theory (SCT) can also help to explain the development of competencies related to balance and falling and describes the role of the self-regulation of health habits, as well as emotional and physical well-being. The SCT suggests that personal, environmental, and behavioral factors are equally influential in regulating one's behavior and behavioral change (Anderson, Wojcik, Winett, & Williams, 2006).

Statement of Purpose

The purpose of this study was to determine if there was a relationship between levels of yoga participation and balance measures of older adults. Levels of participation in yoga and balance measures were each assessed in two ways. Level of participation in yoga was classified as: (a) the number of yoga sessions attended in the last 30 days, and (b) the overall length of time an individual has been involved in yoga. Balance was assessed as (a) a subjective, self-perception of balance scored by the Activities-specific Balance Confidence (ABC) Scale and (b) an objective measure scored by the Multi-Directional Reach Test (MDRT).

Research Questions

This study addressed four primary research questions. Each question explored the relationship between yoga participation and measures of balance among older adults aged 55 years and older who participated in a yoga program.

1. Is there a relationship between number of yoga sessions attended in the past 30 days and scores on the ABC Scale?
2. Is there a relationship between number of yoga sessions attended in the past 30 days and individuals' performance measures on the MDRT?
3. Is there a relationship between the overall length of time individuals have participated in yoga and their scores on the ABC Scale?
4. Is there a relationship between the overall length of time individuals have participated in yoga and their performance measures on the MDRT?

Methods and Procedures

Participants were recruited using advertisements (i.e., flyers) and a personal presentation given by the researcher (prior to a yoga session) at five yoga studios or senior centers in eastern NC. Inclusion in the study required an individual to be 55 years of age or older who practiced freestanding yoga at one of the identified yoga locations. A total of 52 participants volunteered for the study. All participants were asked to complete the IRB consent form, a short demographic questionnaire, the Activities-specific Balance Confidence (ABC) Scale (i.e., a measure of falls efficacy), and the Multi-Directional Reach Test (MDRT) balance assessment.

Study Measurements

Data collection contained a basic demographic questionnaire of each individual, the ABC Scale, and the MDRT balance assessment. Total collection time lasted approximately 15 minutes per individual. Measurements of each participant were taken after the completion of a yoga session. The same room where the yoga session occurred was utilized for study measurements. The two assessments used for this study did not require any specialized training for administration. The researcher collected all data on each of the participants in this study. To make the most efficient use of the participants' time, one participant filled out the questionnaires while another participant completed the balance assessment. Participants then changed roles thus reducing total collection time for all involved. Participants who required help in reading or writing were provided assistance as needed (e.g., reading directions and questions out loud, writing in answers).

Demographics

A short questionnaire was used to obtain demographic data on each individual, such as his or her age, gender, ethnicity, employment status, marital status, history of falls, physical activity levels, and length of yoga participation. Demographic data were used to describe the study participants.

Activities-specific Balance Confidence (ABC) Scale

To determine individuals' self-perceived balance and fall efficacy, the ABC Scale was utilized. The ABC Scale is a 16-item instrument that assesses individuals' level of confidence in performing specific balance tasks without experiencing a fall or feeling off-balance. A score of 67 and less is a predictor of falling for older adults (Powell & Myers, 1995). The ABC Scale has strong validity and reliability when completed independently

by the individual (Talley, Wyman, & Gross, 2007) and is better in detecting poor fall efficacy in older adults than the Falls-Efficacy Scale (Powell & Myers, 1995; Skalkoet al., 2013). Powell and Myers (1995) reported excellent test-retest reliability ($r = 0.92$, $p < 0.001$) in the elderly population. The ABC Scale has an excellent internal consistency for community dwelling older adults with a Cronbach's alpha of 0.96 (Huang & Wang, 2009).

The Multi-Directional Reach Test (MDRT)

Using a yardstick attached to a wall, the MDRT measures how far individuals are willing/able to reach outside his or her base of support in four different directions: (a) forward, (b) backward, (c) left lateral, and (d) right lateral (Newton, 2001). Participants were instructed to stand with their feet shoulder width apart, raise an arm in front at shoulder height parallel to the floor, and reach as far forward as they could without making contact with the yardstick or wall and without moving their feet. Participants were asked to complete the same task in the remaining three directions: backward, left lateral, and right lateral reaches. Each direction had three trials; the first was a practice trial and the next two were recorded trials to calculate an average score. The researcher measured the end of each reach on the yardstick at the middle finger location.

Although the MDRT has no definite cut-off scores for balance, Newton (2001) determined a mean score performance for each direction in older adults who reported tripping or falling in the past six months:

- Forward (in.): 8.38, SD 4.07
- Backward (in.): 4.06, SD 2.94
- Right (in.): 6.12, SD 2.76

- Left (in.): 5.67, SD 3.06

The MDRT has been established as a reliable and valid tool for assessing balance in the four different directions while experiencing an altered center of gravity (Holbein-Jenny, Billek-Sawhney, Beckman, & Smith, 2005). Newton (2001) reported statistically significant correlations for all the reaches ($p \sim .0004$) with the Berg Balance Test in community-dwelling older adults. Research also reports a strong international consistency, or Cronbach's alpha, between 0.80 (Holbein-Jenny et al., 2005), and 0.842 (Newton, 2001). Additionally, adequate construct validity ($ICC = 0.41-0.59$) was reported for each of the directions when compared to the ABC Scale (Holbein-Jenny et al., 2005).

Data Analysis

To determine the relationship between levels of participation in yoga and balance measures of older adults, a series of separate analyses were conducted. In the first set of analyses, descriptive frequencies were run for the demographic variables to generate a profile of the sample population. Next, a linear regression model was used to explore whether yoga participation variables were significant predictors of adults' balance scores of the ABC Scale and MDRT.

Descriptive Analysis of Demographics

Table 1 displays the findings from the descriptive analysis. Data were collected and analyzed for the 52 study participants. The ages of the participants ranged from 55 years to 76 years, and the average age of participants was 63.7 years ($SD = 6.2$). The majority of the study participants were female (86.5%) and White/Caucasian (90.4%). Over half of the participants were retired (55.8%) from employment. Additionally, most

of the participants were married (71.2%). When asked the question, “Are you afraid of falling?”, 19.2% of participants self-reported a FoF. When asked “In the past 6 months have you experienced a fall?”, 17.3% reported yes. Approximately 52% of participants had been practicing yoga for more than two years, 54% attended 0-6 sessions in the past thirty days, and 90% of all individuals participated in physical activities, other than yoga, two or more times a week. Participants’ average score on the ABC Scale was 92.16% out of a possible 100% (SD= 9.8). Additionally, participants’ average reach on the MDRT was: (a) forward= 14.5in. (SD= 2.1), (b) backward= 10.1in. (SD= 2.9), (c) left lateral= 9.5in. (SD= 2.2), and (d) right lateral= 10.7in. (SD= 2.1).

[Insert Table 1]

Linear Regression of Yoga Variables on ABC Scale and MDRT

Analyses were first conducted to determine whether yoga variables (yoga participation or length of time participating and yoga sessions) significantly predicted performance on the ABC Scale and MDRT. The model for the ABC Scale was not significant ($F(2,48) = 0.27, p = 0.76$), and the regression analysis demonstrated there were no significant relationships ($\text{Adj. } R^2 = 0.03$) between the scores on the ABC scale and the independent variables, yoga session ($\beta = 0.08, p = 0.58$) or yoga participation ($\beta = 0.05, p = 0.74$). (See Table 2).

[Insert Table 2]

The regression model for the forward reach of the MDRT was significant ($F(2,49) = 4.26, p = 0.02$) and, overall, 11% ($\text{Adj. } R^2 = 0.11$) of the variance in the MDRT forward reach scores was accounted for by the independent variables included in this model. However, the length of time an individual has engaged in yoga, (i.e., yoga

participation) was the only variable that significantly predicted this measure of balance ($\beta = 0.30$, $p = 0.03$) (See Table 3). The models examining performance on the backward, left, and right reach tests were not significant; neither number of yoga sessions nor length of time engaged in yoga were significant predictors of adults' balance on the backward, left, and right reach measures of the MDRT (See Table 3).

[Insert Table 3]

Discussion

Current literature, although abundant with research of functional gains produced through yoga, is deficient of research exploring the relationship between one's level of yoga participation and measures of balance. Therefore, this study attempted to determine if relationships exist between levels of participation in yoga (i.e., overall lifetime engagement and number of sessions attended in the last 30 days) and balance measures of older adults. While this study demonstrated that the length of time an individual had participated in yoga significantly predicted balance, in terms of their ability to reach forward, no other significant findings were noted with the variables of interest. However, the results do encourage further discussion and investigation to better determine if yoga can be used as an alternative therapeutic intervention for the elderly population. Specifically, it may be possible to improve balance measures and produce better results through a prescribed protocol or by making adjustments in the frequency of participation, the intensity of participation, and the duration of participation in yoga.

The analysis of the 52 older adult participants indicated that overall lifetime engagement in yoga was a significant factor in predicting scores on the forward reach of the MDRT. The results indicated that as one's overall lifetime engagement in yoga

increased so did his or her performance on the forward reach balance measure of the MDRT. Yogafit® founder and author, Beth Shaw (2009), reported that of all the yoga poses (asanas) practiced, individuals were most familiar with those that involve forward bending. She reported that most of forward bending in daily life uses poor body mechanics by bending through the spinal cord and rounding the shoulders, whereas yoga teaches individuals to bend by hinging from the hips with a straight spine in order to prevent falls and injuries.

The findings from this study are supported by the Motor Learning Theory, which states that the acquisition of skilled movements through practice leads to a relatively permanent change (Bergan, 2010; Guthrie, 1952; Tunney et al., 2006). Yoga requires a lot of forward reach motions, so practicing this functional outcome – forward reach by hinging from the hips – would then transfer to other physical activities and demands of daily living to help reduce the risk of falls and injuries. Since the trend seems to indicate that longer lifetime participation in yoga produces better scores on the forward reach of the MDRT, there is merit in keeping individuals engaged in yoga throughout their lifetime.

The Social Cognitive Theory (SCT) suggests that perceived self-efficacy is the core determinant for whether or not an individual will continue to participate in an activity. Thus, individuals who believe they have the capability to achieve the desired outcomes (i.e., self-efficacy) will strategize and implement behaviors as necessary to produce the desired effects (Bandura, 1998). In turn, self-efficacy is particularly important in an individual's initial adoption of an exercise program (Taylor, 2014) because the individual may self-select activities that he or she feels confident about or are

good at for participation. Therefore, introducing activities, such as yoga, at an earlier stage in life may promote increased self-efficacy, which may then encourage greater participation and thus, improve functional gains for the elderly population.

In this study, while lifetime participation patterns significantly predicted performance in the forward reach, it is unknown if specific asanas can produce positive gains in the other measures of balance of the MDRT. While yoga involves a wide range of protocols including various asanas for developing functional outcomes, the results suggest that future research evaluate specific yoga protocols in order to determine those asanas that produce the most effective gains in functional outcomes on each reach measure of the MDRT. These protocols would include some measures of the frequency, intensity, and duration of participation in order to produce the desired outcomes. Recreational therapy professionals in both prevention and active treatment services can then prescribe the most effective approach for developing competencies in distinct directional measures of balance.

In the current study, participation in yoga and measures of balance were generally unrelated. The relationship between the forward reach measure of the MDRT and yoga participation, although statistically significant, was low. While many of the research studies involving yoga report positive results, the lack of a clear and standard definition for “participation in yoga” affects current research findings because “...there is no evidence for determining dose, frequency, and duration for the most effective yoga program” (Zettergren et al., 2011, p. 93). If future research could determine a set protocol and dosage of yoga participation in order to achieve improved functional outcomes such as balance, the results could have a significant impact on the provision of both

therapeutic and preventative yoga services in recreational therapy practice. Recreational therapy professionals may, therefore, encourage greater engagement of both young and elderly clients to participate in yoga as an alternative therapeutic intervention in producing desired functional outcomes, such as improved forward reach balance measures.

Limitations

In this study several limitations are recognized. The use of a cross-sectional study design required all participants to be measured only once at a specific time point. A cross-sectional study research design poses limitations including the absence of a control group and the lack of evaluation of causal relationships between variables.

This study employed non-randomized purposive sampling to gather participants. Specific inclusion criteria (e.g., age and yoga participant) were mandatory for inclusion in the study. The chosen sampling approach led to an under-representation of males and non-Caucasian individuals in the sample population. In addition, 30 participants were aged 55-64 years, twenty were aged 65-74 years, and only two participants were 75 years and older. Thus, the effect of yoga participation on balance among adults aged 75 years and older requires additional investigation.

Perhaps the inclusion of adults from 55-64 years old and already active in yoga resulted in an atypical “older adult” population. Approximately 91% of participants in this study reported participating in physical activities two to seven times a week, which meets the WHO’s *Global Recommendation on Physical Activity for Health* and may represent a more healthy and active sample than other studies with a minimum age requirement of 65 years.

This study sample had fall characteristics that were not very similar to those reported throughout the literature. The CDC (2013) reported that one in three older adults will experience a fall each year. In this study, 17.3% of the sample reported experiencing a fall in the past six months, which differs from previous research in which the sample population experiencing a fall ranged from 35%-47% (Allison et al., 2013; Arnold & Faulkner, 2007; Hornyak et al., 2013). In this study of 52 participants, 19.2% (n=10) reported a FoF. While this study did not address the percentage of participants that had fallen and reported a FoF, previous research states that 40-73% of individuals who have fallen (Jung, 2008) and 20-46% of individuals who have not fallen (Schmid et al., 2010) will possess a FoF.

Since to the majority of the sample were individuals who never experienced a fall and have no self-reported FoF, the relatively high mean scores on the ABC Scale and each directional reach of the MDRT were not surprising. The inclusion of a more diverse and representative population of older adults would afford a more accurate reflection of the results of yoga participation on balance measures.

Conclusions

Although this study demonstrated that participation in yoga and measures of balance in older adults were generally not related, it revealed overall lifetime engagement in yoga significantly predicted the forward reach measure on the MDRT. It is recommended that future research continue to examine the frequency, intensity, and duration of yoga practice for an effective program with this population. In addition, the utilization of a larger sample of older adults with no experience in yoga as an activity would better allow for determining the impact of yoga on measures of balance.

Future research should also examine the most effective asanas for producing functional balance outcomes for the elderly population. Based on the results of this study, yoga may be a potential intervention for adults who need to improve their performance on forward reach measures. Given the extensive research on yoga, it is evident that it has the potential to increase older adults' performance on functional balance outcomes and could be used as an alternative therapy intervention to improve balance impairments. Recreational therapists working with older adults should consider integrating yoga into their practice competencies as a means to address balance as a functional outcome of their services.

Table 1.
Descriptive Statistics of Sample Participants (N = 52).

<u>Demographic</u>	<u>Frequency</u>	<u>Percentage</u>
Gender/Sex		
Male	7	13.5
Female	45	86.5
Marital Status		
Not Married	15	28.8
Married	37	71.2
Race/Ethnicity		
Non-Caucasian	5	9.6
White/Caucasian	47	90.4
Employment Status		
Not Retired	23	44.2
Retired	29	55.8
Fear of Falling		
No Fear	42	80.8
Reported Fear	10	19.2
Falls History		
No falls last 6 months	43	82.7
Reported fall in last 6 months	9	17.3
Yoga Session		
0-6 times a month	28	53.8
7-13 times a month	15	28.8
14-21 times a month	7	13.3
21-30 times a month	2	3.8
Yoga Participation		
1 year or less	13	25.0
Over 1 year to 2 years	12	23.1
More than 2 year to less than 10 years	13	25.0
Greater than 10 years	14	26.9
Physical Activity		
0 to 1 time per week	5	9.6
2 to 3 times per week	18	34.6
4 to 5 times per week	13	25.0
6 to 7 times per week	16	30.8

Table 2.
A Linear Regression Model of the Influence of Yoga Variables on the ABC Scale

	ABC Scale		
	B	SEB	β
Yoga Sessions	0.13	0.23	0.08
Yoga Participation	0.42	1.26	0.05
F		0.27	
Adj. R ²		-0.03	

Table 3
A Linear Regression Model of the Influence of Yoga Variables on the Multi-Directional Reach Test

	Forward			Backward			Left			Right		
	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β
Yoga Sessions	0.06	0.05	0.18	0.09	0.07	0.19	-0.05	0.05	-0.13	-0.02	0.05	-0.07
Yoga Participation	0.53	0.24	0.30*	0.32	0.36	0.13	-0.32	0.27	-0.17	-0.29	0.26	-0.16
F	4.26*			1.71			1.46			0.88		
Adj. R ²	0.11			0.03			0.02			-0.01		

Note. *p ≤ .05

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Appendix A

IRB Approval



EAST CAROLINA UNIVERSITY

University & Medical Center Institutional Review Board Office

4N-70 Brody Medical Sciences Building · Mail Stop 682

600 Moye Boulevard · Greenville, NC 27834

Office **252-744-2914** · Fax **252-744-2284** · www.ecu.edu/irb

Notification of Initial Approval: Expedited

From:	Biomedical IRB
To:	Tori Pinchuk
CC:	Thomas Skalko Tori Pinchuk
Date:	5/19/2014
Re:	UMCIRB 14-000254 Yoga Participation and Balance

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 5/19/2014 to 5/18/2015. The research study is eligible for review under expedited category #4,7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name

ABC Scale

Activities-specific Balance Confidence Scale	Other Medical Procedures/Considerations
MDRT	Standardized/Non-Standardized Instruments
Multi-Directional Reach Test	Other Medical Procedures/Considerations
NoMoreThanMiminalRiskConsentForm05132014	Consent Forms
Questionnaire	Surveys and Questionnaires
Study Protocol	Study Protocol or Grant Application
Yoga Flyer 1	Recruitment Documents/Scripts
Yoga Flyer 2	Recruitment Documents/Scripts
The Chairperson (or designee) does not have a potential for conflict of interest on this study.	

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
 IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

Agency Agreement

Letter of support: Tori Pinchuk, the researcher and graduate student MS Recreational Therapy Administration and _____,

(name of center)

which will hereby be referred to as “the center.”

This agreement outlines the collaboration between Ms. Pinchuk and the center. The collaboration will include permission from the center for the researcher to recruit volunteers, who meet the required criteria, for a study determining the relationship between yoga participation on measures of balance of older adults. The center will provide a room to complete the two measures of balance assessments on the sample of older adult’s that participate in yoga for study inclusion.

_____ and other appointed individuals will serve as the

(name of individual from center)

individual(s) to be contacted for the center.

The researcher will provide experimental structure including a 1) consent form, 2) questionnaire, and 3) two balance assessments. The Researcher will provide all materials for participation in the study and will facilitate the protocol with the sample. The researcher will conduct a statistical analysis of the collected data and report results. The primary point of contact for the research study is Tori Pinchuk, and any individuals with questions regarding the study can contact her. In addition, Dr. Thomas Skalko will support this collaboration as the academic research advisor.

The Researcher

X _____ Date _____

The Center

X _____ Date _____

Does Yoga Influence Balance? Come find out!

- Looking for individuals who participate in yoga and are **55 years of age and older**, to participate in a study for a master's thesis.
- Volunteering will **ONLY take 20** minutes extra of your time!!
- Participants will need to complete a **consent form**, a **short survey** and a **10 minute physical Multi-Direction Reach Test**.

For further information, please contact **Tori Pinchuk**. She is currently a master's student at East Carolina University in the Recreational Therapy Administration Program.

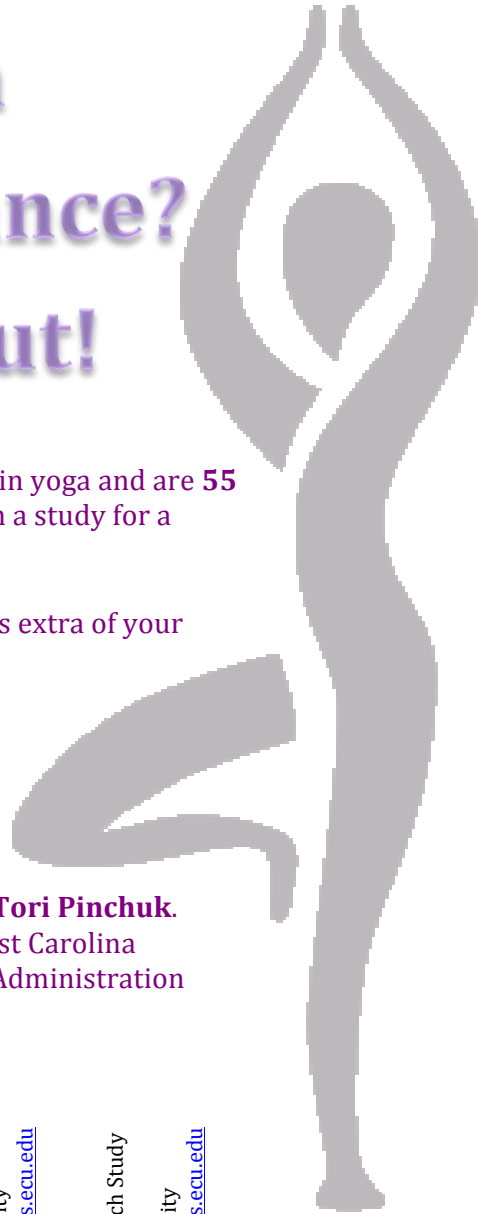
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Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: The Relationship Between Participation in Yoga and Balance Measures of Older Adults

Principal Investigator: Tori Pinchuk

Institution/Department or Division: East Carolina University; Department of Recreation and Leisure Studies

Address: 1413 Belk Building/300 Curry Court, Greenville NC 27858

Telephone #: 252-328-4640

Study Sponsor/Funding Source: Dr. Thomas Skalko

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?

The purpose of this research is to explore the relationship between yoga participation and balance measures of older adults. The decision to take part in this research is yours to make. By doing this research, we hope to learn if yoga is an effective therapeutic intervention in improving balance and fall prevention. Results may have implications for the provision of community-based yoga as a means for balance maintenance.

Why am I being invited to take part in this research?

You are being invited to take part in this research because you meet the two requirements: 1) aged 55 and above, and 2) you participate in yoga classes. If you volunteer to take part in this research, you will be one of about 40 people to do so.

Are there reasons I should not take part in this research?

I understand I should not volunteer for this study if I am younger than 55 years of age and do not participate in yoga.

What other choices do I have if I do not take part in this research?

You can choose not to take part in this research, and you can stop at any time. There are no consequences if you choose not to partake in this study.

Where is the research going to take place and how long will it last?

The research procedures will be conducted at: 1) Vidant Wellness Center, 2) Alice F. Keene Center, 3) Purple Blossom, 4) Greenville Aquatics and Fitness Center, and 5) Diane's Art of Yoga, dependent on which location you are registered for yoga classes. You will need to come to the appropriate site where the research will be conducted 1 time during the study. The primary investigator will be available after a yoga session for your

convenience, and the total amount of time you will be asked to volunteer for this study is 20 minutes.

What will I be asked to do?

You are being asked to do three things: 1) sign this consent form, 2) complete a paper questionnaire and 3) completed a physical assessment of balance. The first part of the questionnaire will ask about some personal demographics, and the second part will be a self-perceived assessment of balance called the Activities-specific Balance Confidence (ABC) Scale. After completion of the questionnaire, you will be asked to complete an actual measure of balance assessment called the Multi-Directional Reach Test. You will be asked to reach as far forward, backward, to the left and to the right as you can. This will conclude your participation in the study.

What possible harms or discomforts might I experience if I take part in the research?

Potential risks of participating in this study can include losing stability, experiencing muscle pain or strains during reaches, and/or the possibility of experiencing a fall. However, it has been determined that the likelihood of these risks occurring is minimal. The primary investigator will position herself in such a way that provides additional support during these reaches. In case you should lose your balance, the primary investigator will be there to assist in regaining balance.

What are the possible benefits I may experience from taking part in this research?

A benefit from participating in this research is finding out your scores on the Multi-Directional Reach Test and how it relates to normative data found on older adults who experience falls. The information gained by doing this research may help us learn more about how yoga can be an effective therapeutic intervention in improving balance and fall prevention for older adult and benefit others in the futures.

Will I be paid for taking part in this research?

We will not be able to pay you for the time you volunteer while being in this study.

What will it cost me to take part in this research?

It will not cost you any money to be part of the research. The primary investigator of this research will pay any of the costs for conducting this study.

Who will know that I took part in this research and learn personal information about me?

To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. However, the information you provide will not be linked to you in any way. Participants will have a participation code only so their questionnaire (anonymous) can be linked to the scores on the MDRT (anonymous) through this code for data analysis purposes. This number can not be linked back to the individual specifically.

With your permission, these people may use your (anonymous) private information to do this research:

- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.
- People designated by Vidant Medical Center and Vidant Health.

How will you keep the information you collect about me secure? How long will you keep it?

The primary investigator will take the surveys from participants manually enter the data into the ECU Qualtrics software system. Copies of the questionnaire, ABC Scale and MDRT results will be destroyed upon entry into the Qualtrics Survey System. In the interim, hard copies will be retained in a locked cabinet in Belk 1409.

What if I decide I do not want to continue in this research?

If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. You will not lose any benefits that you should normally receive.

Who should I contact if I have questions?

The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator at 203-560-0155 (7 days a week, between 9am-5pm)

If you have questions about your rights as someone taking part in research, you may call the Office of Research Integrity & Compliance (ORIC) at phone number 252-744-2914 (weekdays, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the ORIC, at 252-744-1971.

I have decided I want to take part in this research. What should I do now?

The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name(PRINT) Signature Date

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person’s questions about the research.

Person Obtaining Consent(PRINT) Signature Date

Appendix B
Demographic Questionnaire

The Relationship Between Yoga Participation on Balance Measures of Older Adults

1: What is your participation number for this study? (indicated by the index card) _____

2: How old are you? (ex. 55) _____

3: What is your gender? _____Female _____Male

4: Please indicate your Marital Status:

___Single/Never Married ___Married ___Divorced

___Widowed ___Prefer Not to Answer

5: Please indicate your Ethnicity:

___Asian or Asian-American ___Black or African-American

___White or Caucasian ___Hispanic or Latino

___Hawaiian Native or Pacific Islander ___Prefer Not to Answer

6: Please indicate your Employment Status:

___Employed for Wages ___Self-employed ___Retired ___Volunteer work

___Unable to Work ___Out of working and looking ___Prefer Not to Answer

7: Are you afraid of falling? ___Yes ___No

8: In the past six (6 months), have you experienced a fall? ___Yes ___No

9: In the past 4 weeks (1 month), please indicate the number (ex. 16) of yoga sessions you have participated in whether in a studio/class or at home? _____

10: How long have you been practicing yoga? Please indicate years, months or days. For example, if two years, please write “2 years”...If you have only been practicing for 10 days, please write “10 days.” _____

11: Other than yoga, how would you rate your participation in physical activities?

___0-1times a week ___2-3 times a week ___4-5 times a week ___6-7 times a week

The Activities-specific Balance Confidence (ABC) Scale*

Administration:

The ABC Scale can be self-administered or administered via personal or telephone interview. Larger typeset should be used for the self-administration, while an enlarged version of the rating scale on an index card will facilitate in-person interviews. Regardless of the method of administration, each respondent should be queried concerning their understanding of instructions, and probed regarding difficulty answering specific items.

Instructions to Participants:

For each of the following, 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%-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 something, rate your confidence as if you were using these supports. If you have any questions about answering any of these items, please ask the administrator.

Instructions for Scoring:

The ABC Scale is an 11-point scale and ratings should consist of whole numbers (0-100% for each item. **Total the ratings (possible range= 0-1600) and divide by 16 to get each subject's ABC score.** If a subject qualifies his/her response to items #2, #9, #11, #14, or #15 (different ratings for "up" or "down" or "onto" vs. "off"), solicit separate ratings and use the lowest confidence of the two (as this will limit the entire activity, for instance the likelihood of using the stairs).

- 80% = high level of physical functioning
 - 50-80% = moderate level of physical functioning
 - <50% = low level of physical functioning
(Myers, 1998).

 - <67% = older adults at risk for falling; predictive of future fall
(LaJoie, 2004).
1. Powell, L.E. & Myers, A.M. (1995). The Activities-specific Balance Confidence (ABC) Scale. *J Gerontol Med Sci*, 50(1), M28-34.
 2. Myers, A.M., Fletcher, P.C., Myers, A.N., & Sherk, W. (1998) Discriminative and evaluative properties of the ABC Scale. *J Gerontol A BiolSci Med Sci*, 53, M287-M294.
 3. Lajoie, Y., & Gallagher, S.P. (2004). Predicting falls within the elderly community: Comparison of postural sway, reaction time, the Berg balance scale and ABC Scale for comparing fallers and non-fallers. *Arch GerontolGeriatr.*, 38, 11-26.

The Activities-specific Balance Confidence (ABC) Scale

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following scale:

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 the 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 tiptoes 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 the 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 an escalator while you are holding on a railing? _____%
15. ...step onto or off an escalator while holding onto parcels such that you cannot hold onto a railing? _____%
16. ...walk outside on icy sidewalks? _____%

University of Iowa Health Care. (n.d). *The Activities-specific Balance Confidence (ABC) Scale* [PDF document]. Retrieved from: <http://www.healthcare.uiowa.edu/igec/falls-prevention-toolkit/01-practice-fall-gait-assessment/assets/ABC-Scale.pdf>

Functional Reach & Multi-Directional Reach Test

Directions:

Using a yardstick mounted on the wall at shoulder height, ask the subject to position themselves close to, but not touching the wall with their arm and hand outstretched with palm facing towards the floor. Have the subject reach as far forward as possible in a plane parallel with the measuring device.

Instructions: “Reach as far forward as you can without taking a step, keeping your feet flat on the floor, and keeping your hand at the level of the ruler.”

They are free to use various reaching strategies. Take note of the end position of the middle finger against the ruler and record the difference between the starting and ending position numbers. If they move their feet, that trial must be discarded and the trial repeated. Guard the subject as the task is performed to prevent a fall. Subjects are given a practice trial and then their performance on two additional trials is recorded and averaged.

Scores **less than 6 or 7 inches indicates limited functional balance.**

Most health individuals with adequate functional balance can reach **10 inches** or more.

Instructions to the patient:

Please reach as far forward as you can without losing your balance. Keep your feet on the floor. You are not allowed to touch the wall or ruler as you reach. You will have one practice trial and then I will record the distance that you reach forward twice and take an average.

Criteria to stop the test:

The patient’s feet lifted up from the floor or they fell forward. Most patients fall forward with this test. The therapist should guard from the front as that is the direction you reach forward.

Duncan, P., Weiner, D., Chandler, J. et al. (1990). Functional reach: a new clinical measure of balance. *J of Gerontol*, 45. M192-197.

Multi-Directional Reach Test

1. **Forward:** (same as Functional Reach described above)
2. **Backward:** Have individuals face opposite direction and line their middle finger up to the beginning of the yardstick. Have the person lean backward as far as possible.
3. **Left Lateral Reach:** stand with back to wall and left elbow extended with arm reaching along the level of the yardstick (without touching the wall or yardstick). Lean to the left as far as possible.
4. **Right Lateral Reach:** stand facing the wall and right elbow extended with arm reaching along the level of the yardstick (without touching the wall or yardstick). Lean to the right as far as possible.

Reference Values: (Normative data for community-dwelling elderly with a mean age of 74)

- Forward 8.9 ± 3.4
- Backward 4.6 ± 3.1
- Right 6.2 ± 3.0
- Left 6.6 ± 2.8

Newton, R. (2001). Validity of the multidirectional reach test: A practical measure for limits of stability in older adults. *J Gerontol Med Sci.*, 56A. M248.

Retrieved from: geriatrictoolkit.missouri.edu/Functional-Reach.rft

Multi-Directional Reach Test Score Sheet

Summer 2014

Assessments provided by East Carolina University Recreational Therapy Administration
Master's student, Tori Pinchuk LRT/CTRS

	Recorded Trial 1	Recorded Trial 2	Average
Forward			
Backward			
Left Lateral			
Right Lateral			

Scores:

Falls Risk- Community-Dwelling Elderly: (Newton, 2001). Mean scores in each directions for individuals who reported a trip or fall in the last 6 months.

Forward (in): 8.38 (4.07)
Backward (in): 4.06 (2.94)
Right (in): 6.12 (2.76)
Left (in): 5.67 (3.06)

Normative Data: Community-Dwelling Elderly (Newton, 2001)

	Mean	SD
Forward Reach (in)	8.89	3.4
Backward Reach (in)	4.64	3.1
Right Reach (in)	6.86	3.0
Left Reach (in)	6.61	2.9

APPENDIX C

Extended Literature Review

Therapeutic use of yoga for falls prevention in older adults

Introduction

In the United States, the population of older adults is growing dramatically (Chen, Tseng, Ting, & Huang, 2007; Close, Lord, Menz, & Sherrington, 2005), and the World Health Organization (WHO) projects that two billion people worldwide will be aged 60 years and older by 2050 (WHO, 2012a). Research states that many older adults do not achieve the recommended amount of physical activity and exercise, which increases the risk of various health issues (Stevens et al., 2014; Taylor, 2014; U.S. Department of Health and Human Services, 2008; Yorston, Hons, Kolt, & Rosenkranz, 2012). Even though there are many health concerns for older adults associated with the normal aging process and the lack of physical activity, falling is considered one of the major health risks to this population and the primary cause of injury (Centers for Disease Control and Prevention, 2013).

Centers for Disease Control and Prevention (CDC) reported that the number of older adults hospitalized for fall-related injuries is five times greater than hospitalizations for any other injury in the same population. On average, a fall-related hospitalization costs \$34,294, making fall injuries one of the top 20 most highly costing medical conditions. Additionally, the total direct medical cost for fall injuries is projected to reach \$67.7 billion by 2020 (CDC, 2014a).

Every year, approximately 30% of independently living older adults will experience at least one unexpected fall (Arnold & Faulkner, 2007). Blochet et al. (2009)

discovered that nearly 40% of older adults who experience a fall are unable to get back up independently. Furthermore, individuals who experience a fall are about three times more likely to experience another fall within the same year (Hakim, Kotroba, Cours, Teel, & Leininger, 2010).

After a fall, older adults are especially prone to developing a fear of falling (FoF), which can be just as harmful as the actual fall itself. Huang, Chi, and Hu (2013) state that FoF can result in more falls, depression, reduced ability to execute activities of daily living (ADL's) and increased limitations of physical activity. FoF was reported in 40-73% of older adults who experienced a previous fall and 20-46% of older adults who have never fallen (Schmid, Van Puymbroeck, & Kocaja, 2010). Fear of falling is also associated with reduced execution of functional balance tasks (Huang et al., 2013).

Researchers have identified that impaired balance and decreased strength in the lower extremities are significant risk factors in the reduction of physical functioning and occurrence of falls in older adults (Ceceli, Gökoğlu, Köybaşı, Çiçek, & Yorgancıoğlu, 2009; Granacher, Gollhofer, Hortobágyi, Kressig, & Muehlbauer, 2013). Often impaired balance and decreased strength have been corrected with resistance training, however the benefits of resistance training did not correlate to improvement in functional tasks, balance, ADL's and reduced fall rates in some studies (Granacher et al., 2013). Researchers (Howe, Rochester, Neil, Skelton, & Ballinger, 2012) have identified exercise interventions focusing on balance training as the most effective technique in reducing falls in older adults.

Research demonstrated an association between yoga and balance measurements of older adults and reveals yoga may be an appropriate intervention for older adults to

improve balance and reduce the likelihood of experiencing a fall (Hakim et al., 2010; Morris, 2008; Patel, Newstead, & Ferrer, 2012; Schmid et al., 2010; Tiedemann, O'Rourke, Sesto, & Sherrington, 2013). In the United States, physicians refer 14 million people (6.1% of the population) to participate in yoga as a therapeutic intervention (Roland, Jakobi, & Jones, 2011), making yoga one of the top10 commonly used alternative therapies (Zettergren, Lubeski,& Viverito, 2011). While there has a been a dramatic growth in participation of yoga as an alternative therapy, minimal research has evaluated the relationship between level of participation in yoga and balance measures of older adults.

The purpose of this literature review is to explore current studies on physical activity for older adults, the issues related to the fear of falling with this population, and the role of balance. The use of yoga as an alternative intervention strategy for balance and falls reduction in the older adult population will also be reviewed.

Literature Review

Physical Activity and the Older Adult

The World Health Organization's (WHO) *Global Recommendations on Physical Activity for Health* states that older adults should participate in at least 150 minutes of moderate-intensity aerobic activity per week with at least two days of muscle-strengthening activities and three or more days of balance exercises (WHO, 2010). The WHO defines physical activity as “any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, traveling and engaging in recreational pursuits” (WHO, 2014, para. 1). Despite these recommended guidelines and the numerous well-

known benefits of exercise, physical activity rates are very low in older adults over the age of 50 years.

The U.S. Department of Health and Human Services (2008) states that more than 60% of adults 50 years and older in the United States do not engage in the recommended amount of physical activity. Another important finding concludes that older adults are the most inactive population, with only approximately 31.5% of adults aged 65-74 years and 17.6% of adults aged 75 and older meeting the recommended physical activity guidelines (CDC, 2009).

According to the WHO (2014), physical inactivity is linked to nearly 3.2 million deaths every year. Physical inactivity can lead to declines in muscle strength, muscle mass, endurance, balance ability, and cognitive performance. Consequently, physical inactivity and these associated declines impact an individual's overall functional independence (Allison, Painter, Emory, Whitehurst & Raby, 2013; Hornyak et al., 2013; Taylor, 2014; WHO, 2010).

Physical restrictions in older adults reflect declines in physical functioning such as mobility and balance. In a study on 82 community-dwelling older adults, Allison et al. (2013) concluded that the degree of participation in physical activity is strongly related to clinical performance measures for both mobility and balance. Additionally, the increases in physical restrictions can lead to the phenomena known as fear of falling (FoF), which creates a vicious circle for older adults by restricting their activity level due to the fear of experiencing a fall (Allison et al., 2013; Huang et al., 2013). This statement is supported by a study on 78 community-dwelling older adults by Hornyak et al. (2013), who confirm that there is a significant association between physical functioning and fear of falling.

The results suggest that individuals with a FoF restrict their levels of physical activity and this consequently affects their overall physical functioning.

Increasing physical activity levels is the most effective way to improve physical functioning in the older adult population (Paterson, Jones, & Rice, 2007; Yorston, Kolt, & Rosenkranz, 2012). Physical activity may delay functional limitations and reduce the progression of functional decline for older adults with and without disabilities (Paterson et al., 2007; Tak, Kuiper, Chorus, & Hopman-Rock, 2013; Taylor, 2014). In the first meta-analysis of physical activity and prevention of onset and progression of basic ADL disability, Tak et al. (2013) demonstrated that physical activity not only prevents but also slows down age-related functional declines that cause ADL disability. The results emphasize that any physical activity above a low level is beneficial in reducing disability in older adults. This finding is consistent with the results from Yorston et al.'s (2012) study. In a sample of 91,375 Australian older adults, individuals who participated in higher levels of physical activity reported higher physical functioning scores than individuals who were less physically active. Additionally, results indicated that loss of functional independence might be decreased by as much as 30% for older adults who attain the recommended levels of physical activity (Yorston et al., 2012). The strong evidence of the effects of physical activity on functioning only reinforces the need to increase physical activity levels and overall functional health in the older adult population (Taylor, 2014).

Falls & Fear of Falling

Approximately 424,000 individuals die from fall-related injuries every year, making falls the second leading cause of accidental deaths worldwide (WHO, 2012b).

Falling contributes to 77% of all injury-related hospitalizations among the older adult population (Arnold & Faulkner, 2007). The average length of stay in the U.S. for a fall-related hospitalization is 22 days although this is dependent on the severity of the fall (WHO, 2007). Additionally, fall-related injuries are considered one of the top 20 most costly medical conditions, with an average cost of \$34,294 for one hospitalization (CDC, 2014a). Furthermore, it is projected that the U.S. will spend \$240 billion on fall-related hospitalizations by 2040 (WHO, 2007).

Falling can be attributed to a single or a combination of multiple risk factors. Over 400 potential risk factors have been identified in the literature including: impaired balance, lower extremity muscle weakness, impaired cognition and vision, decreased mobility, impaired ability to perform ADL's and environmental factors (e.g. slippery surfaces, insufficient lighting, uneven sidewalks) (Close et al., 2005; DiBrezza, Shadden, Raybon, & Powers, 2005; WHO 2007; WHO, 2012b). In addition, aging is considered a main risk factor for falling.

The highest risk for injuries or death related to falls is observed in the older adult population (WHO, 2007). One in three adults aged 65 and above will experience a fall each year (Arnold & Faulkner, 2007; WHO, 2007). The probability for falls rises to 50% for adults aged 85 and above, and of all the individuals who experienced a fall, half will do so repeatedly within the same year. The occurrence of falls is significantly higher (1.5 times) for older adult women than men (Close et al., 2005). However, fatal fall rates for men exceed that of women regardless of the fewer occurrences of falls. Possible explanations for this include the fact that males engage in higher levels of risk-taking

behaviors and that men experience more co-morbid conditions than women (WHO 2007; WHO, 2012b).

After a fall, older adults are especially prone to developing a fear of falling (FoF), which can be just as harmful as the actual fall. In the literature, FoF does not have one clear cut definition. Greenberg (2012) proposed a definition that combines the different ideas of FoF: “a psychological barrier to performing and participating in physical activities and is predictive of future falls” (p. 114).

Effectively measuring FoF in older adults is quite difficult due to the lack of clarity on the best assessment tool. Currently, FoF is being evaluated in two different ways: (a) as a level of concern about falling and (b) as a level of self-efficacy or one’s confidence level in completing common ADLs without falling (Greenberg, 2012; Jung, 2008). A single-item measure, including “Are you afraid of falling?” has been used to produce a dichotomous yes/no response from the individual to measure concern of falling. Even though this form of measurement is direct and simple, it does not measure an individual’s level of fear (Greenberg, 2012).

An example of a self-efficacy measurement of FoF is the Activities-specific Balance Confidence (ABC) Scale, which evaluates the individual’s level of confidence to maintain balance while performing 16 various ADLs. Powell and Myers (1995) developed the scale and noted that it is more appropriate for individuals who are considered active due to some of the complex items, such as standing on a chair to reach things, or walking on icy sidewalks. Additionally, fall self-efficacy measures may not provide a true representation of FoF for a few reasons: (a) one’s physical functioning can strongly influence the relationship between FoF and self-efficacy to engage in activities

and (b) older adults could still be fearful of experiencing a fall, although they may be confident in their ability to perform activities without “being concerned” of falling (Juang, 2008). After reviewing different FoF measurements, both Greenberg (2012) and Jung (2008) concluded that no single measurement can completely demonstrate the perception of FoF in older adults.

Whether or not an individual has a history of falling or not, FoF is still highly reported among community-dwelling older adults (Jung, 2008). Nearly 40-73% of older adults who experienced a previous fall and 20-46% of older adults who have never fallen reported a FOF (Schmid et al., 2010). Regardless if FoF is related to a previous fall or not, this fear still has serious implications for older adults.

Numerous negative consequences for older adults have been linked to FoF including decreases in health status and balance abilities and increases in fall risks and institutionalizations (Allison et al., 2013; Hornyak et al., 2013; Huang et al., 2013; Jung, 2008). In addition, FoF is strongly correlated with restrictions in activity participation for individuals with a history of falls and individuals with no history of falls (Allison et al., 2013; Jung, 2008). Restriction in activity participation due to FoF is more prevalent in inactive older adult women (Allison et al., 2013). Research states that older adults who restrict their level of participation in activities can have more muscle atrophy and poorer balance, which consequently can lead to future falls (Allison et al., 2013; Huang et al., 2013; Jung, 2008). DiBrezza et al. (2005) states that physical activity is one preventative measure that can help reduce or prevent falls in older adults. In a comprehensive literature review, Jung (2008) concluded that older adults engaging in exercise programs reported less FoF and fewer falls.

Balance

Seventy-five percent of individuals over age 70 have balance impairments (Dillon, Gu, Hoffman, & Ko, 2010). The concept of balance is very complex in nature but is a fundamental element that needs to be assessed in older adults (Ceceli et al., 2009; Howe et al., 2012; Suri, Kiely, Leveille, Frontera, & Bean, 2009). Balance, as defined by Shumway-Cook and Woollacott (2007) is the ability to maintain the body's center of gravity over the base of support and is essential in successful performance in activities of daily living (ADL's), recreational pursuits and fall avoidance in older adults.

It is important to understand how healthcare professionals assess balance, as this critical appraisal can help optimize quality of care for their consumers. An individual's balance control can be measured when the individual is standing still and maintaining a constant base of support or when the individual is maintaining a stationary position while completing a task. Furthermore, indirect measures of balance control, such as self-reporting or observation can be implemented (Howe et al., 2012). Assessing an individual's functional balance is necessary in order to accurately diagnose possible impairments, identify future fallers, and provide appropriate treatment to decrease the likelihood of falls (Rantz, Skubic, Miller, & Krampe, 2008; Rubenstein, 2006; Skalko, Sauter, Burgess, & Loy, 2013).

Newton (2001) states that the ability to safely and confidently execute activities requires an individual to produce appropriate motor techniques when stationary or while in motion. Since ADL's and recreational activities require motor movements such as reaching up, reaching to the side, or bending over, an individual needs to be able to accurately shift their balance to accommodate for specific tasks. When an individual's

center of gravity moves out of line with his or her base of support, it exceeds his or her limits of stability for the performed task. If an appropriate motor strategy is not performed to realign the center of gravity with the base of support, the individual may lose his or her balance and/or fall (Newton, 2001). Therefore, it is mandatory to utilize balance assessments to identify at risk older adults and prescribe effective therapy interventions to help improve overall balance performance.

A large and growing body of literature has emphasized the importance of physical exercise programs on balance improvements in older adults. Exercise that gets older adults on their feet and incorporates balance training has been named the best approach to reducing risks of falls in older adults (Howe et al., 2012; Seco et al., 2013; Skalko et al., 2013).

In a pilot study by Suri et al. (2009), the relationship between trunk muscle strength (TMS) and endurance to balance and mobility of older adults was evaluated using 70 community-dwelling older adults with mobility limitations. A significant association between TMS and trunk extension endurance with mobility and balance in older adults was reported (Suri et al., 2009). These results are consistent with later findings from Granacher et al. (2013) in the first systematic review to examine the association between TMS and balance. The study discovered small, but significant, correlations between TMS, balance, functional performance and falls in older adults. It was suggested that the best exercise strategy to help reduce age-related deficits in TMS, balance, functional performance and falls for older adults is through the provision of a core strength-training program paired with a balance exercise program.

Other researchers have shown positive improvements in balance of older adults participating in either daily flexibility group exercises (Ceceli et al., 2009) or a simple but long-term physical activity-training program (Seco et al., 2013). Ceceli et al. (2009) sought out to compare functional activity, flexibility, and balance of older adults who were sedentary and among older adults who were participating in a flexibility intervention. Twenty-five individuals engaged in a range of motion exercise group three times a week for four months, while 21 individuals maintained a sedentary lifestyle in the control group. Significant improvements were observed in functional activity and flexibility in individuals in the exercise group. Also, improvements in balance of these individuals were reported, although the results were not significant (Ceceli et al., 2009). In a similar study, Seco et al. (2013) evaluated the effects of a physical activity program on flexibility, strength, cardiovascular fitness and balance of 227 community-dwelling older adults after nine months, and again three months later. Significant improvements were observed in all of the measures at the end of the training period (i.e., 9 months), but only flexibility and balance improvements were maintained three months after training. The findings from these studies have strong implications for interventions and programs targeting older adults, and suggest that balance can be significantly improved through the use of physical activity programs.

Some types of interventions or activity programs may be more appropriate and effective for preventing falls in the aging population. It is suggested that older adults participating in Pilates, tai chi and/or yoga have positive improvements in their performance of functional balance tasks and reduce their chances of experiencing falls (Granacher et al., 2013; Hakim et al., 2010). Pilates exercise training has been noted as an

appropriate alternative intervention to traditional resistance and training programs for healthy men and women aged 60 years and above (Granacher et al., 2013). Additionally, tai chi and yoga have shown to improve balance among older adults. Hakim et al. (2010) noted significantly higher scores on the Multi-Directional Reach Test (MDRT) in 21 participants who participated in tai chi and 11 participants practicing yoga for 8 weeks compared to a control group of 20 individuals engaging in no exercise. They concluded that older adults participating in alternative types of exercises, such as tai chi and yoga receive improvements in balance performance (Hakim et al., 2010).

Theoretical Foundation for Yoga as an Intervention Strategy

Motor learning theory describes the process of enhancing the individual's ability to learn, recall and perform new motor skills. In yoga, motor recall is enhanced while practicing yoga poses (asanas) and motor sequences through verbal instructions, visual demonstrations and knowledge of results (KR) provided by the instructor.

The Social Cognitive Theory (SCT) can also help to explain the development of competencies related to balance and falling and describes the role of the self-regulation of health habits, as well as emotional and physical well-being.

Motor Learning Theory. Motor learning is defined as the area of study that focuses on the acquisition of skilled movements through practice or experience that leads to a relatively permanent change (Bergan, 2010; Guthrie, 1952; Tunney et al., 2006). Motor learning emphasizes how individuals learn and perform new motor skills and operates as the foundation for learned practice (Cole, 2008). A motor skill is described as the ability of an individual to operate skeletal muscles efficiently in order to accomplish certain behaviors or acts (Järvilehto, 2006).

The motor learning theory is best explained using three components. Cole (2008) states that the working memory, also known as the short-term memory, is responsible for learning new motor movements. He also identifies that the long-term memory is responsible for recalling and executing the newly learned movement at the same accuracy level as during the training stage. The final and most critical part of the motor learning theory is KR or information provided to an individual about their performance (Winstein & Schmidt, 1990). The main goal of the motor learning theory, through these three components, is generalization or the ability to transfer over what has been learned and apply it to an innovative but comparable task (Bergan, 2010).

Providing KR allows an individual the opportunity to improve functional performance by correcting any errors. Researchers indicate that participants significantly increased their motor learning when repeating movements after being provided KR only on their successful performances only (Badami, Vaez Mousavi, Wulf, & Namazizadeh, 2011; Chiviakowsky & Wulf, 2007; Chiviakowsky, Wulf, Wally, & Borges, 2009; Saemi, Porter, Ghotbi-Varzaneh, Zarghami et al., 2012). Additionally, the provision of KR only on successful performances significantly increased participants' motivation to continue practicing (Badami et al., 2011; Wishart & Lee, 2005).

Older adults experience declines in accurate performance of tasks due to biological changes associated with aging. Tunney et al. (2003) compared the ability of learning a functional motor task using a single session of directed practice on 30 younger adults (ages 20-35 years) and 30 older adults (ages 61-93 years). Declines in motor learning at time of instruction and performance 48 hours later were associated with increased age. Later findings from Boyd, Vidoni, and Siengsukon (2008) revealed that

older adults displayed poorer performance when compared to other age groups, and failed to learn the repeated sequence despite practice. This discovery corroborates the ideas of Voelcker-Rehage and Alberts (2007), who suggested that the ability to divide attention in dual-tasks is limited to older adults, regardless of the length of practice.

Recently investigators have examined the effects of mental practice on the ability to learn a new motor skill. Tunney et al. (2006) investigated the effects of mental practice on retention of a newly learned motor task in 19 community-dwelling older adults and discovered that the experimental group, who mentally rehearsed the task between training and testing, scored significantly higher than the control group. Evidence from this study suggests that mental practice results in higher retention of a newly learned motor skill for older adults (Tunney et al., 2006). In a more recent study, Altermann, Martins, Carpes, and Mello-Carpes (2014) used a cross sectional study with 45 young adults (aged 18-30 years) and 45 older adults (aged 65 years and above) and reported that older adults rely strongly on mental practice for the acquisition of a motor skill. Older adults who mentally practiced the motor skill also displayed a significantly greater reduction in time required to perform the task. From these findings, Altermann et al. (2014) conclude that for the older population, mental practice can benefit the learning and performing of a new motor skill.

Social Cognitive Theory. Albert Bandura describes the Social Cognitive Theory (SCT), formerly known as the Social Learning Theory, as “... a core set of determinants, the mechanism through which they work, and the optimal ways of translating this knowledge into effective health practices” (Bandura, 2004, p. 114). The SCT suggests that personal, environmental, and behavioral factors are equally influential in regulating

one's behavior and behavioral change (Anderson, Wojcik, Winett, & Williams, 2006). The SCT is composed of three core set determinants: perceived self-efficacy, outcome-expectancy and self-regulation.

The first core determinant that Bandura speaks of is perceived self-efficacy– the belief that one possesses the ability to strategize and implement the desired effects. Perceived self-efficacy stems from the knowledge of different health risks and benefits. If individuals are unaware of negative habits affecting their health, then they have little reason to change their current lifestyle. For this reason, Bandura states that knowledge of health risks and benefits is a prerequisite for change. Additionally, perceived self-efficacy is classified as the main motivating factor and plays a fundamental role in the overall structure of SCT because individuals will only change their health habits if they believe they have the capability to achieve the desired outcome(s) (Bandura, 1998). A recent study by White, Wójcicki, and McAuley (2012) evaluated self-efficacy and physical activity over an 18-month period in 227 adults aged 50 and above. The researchers determined that self-efficacy was the strongest predictor and indirectly influenced physical activity participation. These findings replicated previous studies including Perkins, Multhaup, Perkins, and Barton (2008) who explored self-efficacy in relation to participation in physical and social activities in older adults in the U.S. and Spain. Perceived self-efficacy was found to be a significant explanatory factor of participation in social and physical activities for older adults in both countries. Additionally, McAuley, Jerome, Marquez, Elavsky, and Blissmer (2003) reported significantly higher changes in self-efficacy in 174 formerly sedentary older adults after participating in 6-months of walking and stretching activities. In these studies, it was discovered that a greater level of

perceived self-efficacy led to a higher level of participation in physical activity for older adults (McAuley et al., 2003; Perkins et al., 2008; White et al., 2012).

Another concept identified in SCT is outcome expectancies, which are the expected negative and positive consequences that result from engaging in healthy habits (Anderson et al., 2006). There are three different forms of outcome expectancies: physical, social and self-evaluation. Physical outcomes relate to beliefs one has about physical experiences as a result from engaging in the new habit, such as weight loss. Social outcomes refer to the belief that one has about the opportunity for socialization through the new habit. The final outcome, self-evaluative outcome refers to the positive and negative reactions one has about their new health status and behavior. These three outcomes work together to form the primary belief— If an individual has greater expectations they will have a great adherence and participation in the given activity (Bandura, 2004; White et al., 2012). A study by Umstatted and Hallam (2007) examining three SCT variables on 98 older adults' exercise behavior discovered that all three variables together were significantly correlated with exercise, but outcome expectations only had a minor effect on physical activity. However, in a more recent study White et al. (2012) found that physical activity levels were directly associated to changes in both physical and social outcome expectations across time, independent of self-efficacy measures.

The final determinant of the SCT is self-regulation, which is defined as the personal regulation of a goal or performance that is driven by goal setting and self-monitoring. Personal goals provide guidance and incentives for individuals seeking new health habits, and long-term goals help set the path for personal change. Goal setting

provides an individual the opportunity to self-monitor their behavior and they can compare their negative or positive progress to the attainment of the goal. A study using a randomized 12-week intervention determined that participants who set higher goals for physical activity displayed greater levels of self-efficacy, commitment and intention about reaching their goal. In addition, these individuals experienced greater levels of physical activity (Dishman, Vandenberg, Motl, Wilson, & DeJoy, 2009). These findings are consistent with previous results from Nothwehr and Yang (2007) who examined whether changes in goal-setting frequency for 385 individuals trying to lose weight predicted changes in use of diet and physical activity strategies. It was noted that goal setting was strongly linked to both behavioral strategies for losing weight. Additionally, Nothwehr and Yang (2007) concluded that the strong association between goal frequency and self-regulation is "... not surprising as both involve paying attention to one's behavior (p. 537).

The practice of yoga involves individual motor performance and personal goal setting across time to acquire physical and emotional competence. Yoga poses, or asanas, help individuals achieve physical competence by increasing flexibility and static muscle strength. Yoga is theorized to physically and emotionally create balance by using asanas combined with breathing techniques (Feuerstein, 2000). Therefore, consistent yoga practice influences the behavior of the individual in both the physical and affective domains by allowing the individual to focus inward on mental and physical states (Datillo, 2000).

Yoga Emerging as Alternative Therapy

Yoga originates from the Sanskrit term *yuj* meaning “to join”, and signifies the integration of the mind and body in a complete union (Hayes & Chase, 2010; Roland et al., 2011). “Yoga in the United States may be said to have its beginning in the late 19th and early 20th centuries, when yoga filtered into the West...” (Hayes & Chase, 2010, p. 32). During this time, a modification occurred focusing on the physical combination of asana, pranayama, and meditation. This variation, which resulted in over 40 various health benefits (McCall, 2007), requires an individual to remain focused (meditation) to complete the pose and control the body (asana) while breathing at a steady rate (pranayama) (Hayes & Chase, 2010; Roland et al., 2011).

Yoga participation in the United States is steadily on the rise with approximately 86% of health and fitness clubs across the country offering classes (Cowen & Adams, 2007). In the most current “Yoga in America” survey (2012), it is reported that 20.4 million people practice yoga, which is a 29% increase from the previous 2008 study. Macy (2008) reported that individuals aged 55 years and above represent nearly 18.5% of yoga participants. In one study, of all the individuals practicing yoga, approximately half (49.4%) testified to using yoga as a way of improving their overall health (Hayes & Chase, 2010). Furthermore, research states that yoga is considered one of the top 10 commonly used alternative therapies in the United States (Zettergren et al., 2011) with over 14 million individuals receiving referrals by physicians to practice yoga (Roland et al., 2011).

The health benefits of yoga are numerous and well documented in the literature. Yoga has been associated with positive improvements in many health outcomes

including: cardiovascular functioning (Lipton, 2008), hypertension (Hayes & Chase, 2010; Raub, 2002), pain management (Chen et al., 2007; Patel, Akkihebbalu, Espinoza, & Chiodo, 2011; Raub, 2002), anxiety (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Lipton, 2008), asthma (Hayes & Chase, 2010; Raub, 2002), diabetes (Raub, 2002), mood (Raub, 2002), lower back pain (Hayes & Chase, 2010; Lipton, 2008), gait and mobility (Patel et al., 2011), strength (Hayes & Chase, 2010; Taylor, 2001; VanPuymbroeck & Hsieh, 2010) and flexibility (Chen et al., 2007; Ross & Thomas, 2010).

Additionally, research has noted an association between yoga and balance measures of older adults (Hakim et al., 2010; Morris, 2008; Patel et al., 2012; Schmid, Van et al., 2010; Tiedemann, O'Rourke, Sesto, & Sherrington, 2013). Current literature suggests that yoga may be an ideal alternative therapeutic intervention to improve balance and prevent falls in older adults. Following a systematic review of 18 yoga studies on physical functioning, Patel et al. (2012) stated, "yoga may be superior to aerobic exercise interventions to improve self-rated physical health status..." (p. 913).

Tiedemann et al. (2013) conducted a blind and randomized controlled trial on 54 older adults who were previously not active in yoga or tai chi. A significant improvement in standing balance and the one-legged stand with eyes closed was witnessed only in the yoga group after 12 weeks; no significant differences were observed in falls-efficacy as measured by the Short Falls Efficacy Scale- International. Tiedemann et al. conclude that a one-hour yoga class, two times a week for 12 weeks, is beneficial in improving balance of older adults.

Other studies have also demonstrated that participation in yoga results in improved balance measures for older adults. Morris (2008) examined the effects of a twice-weekly hour yoga class for 8 weeks on 18 female older adults' balance and falls confidence. Results suggested that both yoga and the balance training led to improvements in postural control, self-efficacy and reduction of fear. While there were no significant differences in the effectiveness of yoga versus balance training on outcomes, the yoga participants had higher scores on postural control and falls confidence when compared to the balance-training group. Morris concludes, "with the largest percentage of fall prevention owed to postural control to move around in the environment, yoga may be more effective at decreasing fall risk" (p. 83).

The Morris (2008) results are consistent with the findings of Schmid et al.(2010). These researchers conducted a biweekly 12-week yoga program to determine whether FoF and balance would improve among 14 older adults who all reported a FoF at baseline. A modest decrease (6%) was found in FoF after 12 weeks, but it was not significant. However, a significant increase in static balance was reported between baseline and post-intervention. Schmid et al. (2010) concluded that yoga "is a plausible intervention to positively impact both FoF and balance in older adults" (p. 580).

In a study by Hakim et al. (2010), older adults participating in 8 weeks of yoga had substantial improvements in both lateral reaches of the MDRT (i.e., left and right lateral) compared to the non-exercisers. While tai chi participants outperformed the yoga group on all directions of the MDRT, the yoga group exhibited the highest scores on the ABC scale, indicating a reduced FoF not observed in the Tai Chi or non-exercise group. Based on their findings, Hakim et al. (2010) conclude that older adults participating in tai

chi or yoga may demonstrate better balance functioning than those not participating in structured exercise.

In conclusion, current research supports improvements in balance and reduced falls for older adults participating in yoga. However, most studies do not focus on the relationship between degree of participation in yoga and physical health outcomes. In a qualitative pilot study examining the level of participation in yoga to identify self-reported outcomes and benefits, twelve primarily Hispanic females (aged 65-89) reported overall improved balance and fewer falls after a 100% attendance rate in a yoga intervention for 12-weeks (Patel et al., 2011). While the 100% participation rate was identified as a factor in the Patel et al. study, Brown, Koziol, and Lotz (2008) showed positive improvements in 22 older adults from baseline to three months on all balance measures including the ABC scale, regardless of the participants' attendance rate. Despite these positive findings, there is a lack of a clear and standard definition for "participation in yoga" in the literature. Since most studies do not focus on the relationship between degree of participation in yoga and physical health outcomes, more research needs to be conducted in order to determine if a relationship exists between the level of participation in yoga and functional outcomes, specifically to increase balance and prevent falls for older adults.

Summary

As noted by the World Health Organization (2012a), there will be approximately two billion people worldwide aged 60 years and older by the year 2050. This growing population of older adults will be challenged with a wide range of health-related issues. The maintenance of a physically active lifestyle and participation in a range of physical

activity interventions are critical for reducing the various health risks for this population. Yoga has been identified as one appropriate alternative therapy intervention for older adults to help improve overall balance and reduce the risks of fall.

Appendix D

Extended Study Design and Methods

This study used a cross-sectional design, providing an observational study with data collected on a population at one specific point in time. Individuals aged 55 years and older who participated in yoga were asked to partake in the study. A purposive sampling technique was utilized for participant recruitment.

The Institutional Review Board (IRB) at East Carolina University (ECU) approved all procedures used for this research. Inclusion in the study required participants to: 1) read and sign the consent form approved by the IRB, 2) fill out a short demographic questionnaire, 3) complete the Activities-specific Balance Confidence (ABC) Scale, and 4) participate in the Multi-Directional Reach Test (MDRT) for the four corresponding directions (i.e., forward, backward, left lateral, and right lateral).

Sample and Participant Selection

The researcher identified several yoga studios and senior centers in Greenville, NC that offered yoga programs to older adults. The facilities were contacted and the nature of the study was explained to the management at each location. Five studios agreed to participate. The manager of each facility then put the researcher in contact with their various yoga instructors. The yoga instructors provided the researcher class schedule(s) and highlighted the classes that had a large number of older adults who attended.

Upon approval of the IRB, advertisements were posted at each of the facilities to recruit participants. Additionally, the researcher made individual visits to the selected yoga classes within the facilities to provide a short presentation explaining the

study (i.e., purpose, expectations, and questions). After the presentation, a sign up sheet was made available for interested individuals to schedule a day and time for data collection.

Participants for this study were volunteers obtained via a purposive sampling technique of those aged 55 years or older who were currently participating in freestanding yoga at one of the five facilities. The only exclusion criteria were individuals under 55 years of age. A total of 52 individuals agreed to participate in the study. Prior to any data collection, each participant received a full explanation of the study (i.e., purpose, risks, expectations) and was asked to read and sign the consent form if they agreed to the conditions of the study. All participants completed a short demographic questionnaire, an ABC Scale falls efficacy questionnaire, and the MDRT balance assessment. The protocols for each assessment were utilized with each participant and a score was recorded for their single evaluation.

Procedures

All interested individuals with signed consent forms were contacted to schedule a mutually agreed upon date for data collection. All participants were told data collection would take up to 20 minutes on their scheduled date. During this time, participants were asked to complete the short demographic questionnaire, the ABC Scale, and the MDRT. All data collection was performed in the exercise room at the various facilities following the completion of the yoga session.

Study Measurement

Data collection contained a basic demographic questionnaire of each individual (i.e., age, gender, ethnicity, physical activity, falls history), the ABC Scale, and the

MDRT balance assessment. Total collection time lasted approximately 15 minutes per individual. Measurements of each participant were taken in the same room at the end of a yoga session. The two assessments used for this study did not require any specialized training for administration. The researcher collected all data on each of the participants in this study. To increase efficiency of data collection, one participant filled out the questionnaires while another participant completed the balance assessment with the researcher. Participants then changed roles thus reducing total collection time for all involved. Participants who required help in reading or writing were provided assistance as needed (e.g., reading directions and questions out loud, writing in answers).

Demographics

A short questionnaire was used to obtain demographic data on each individual such as their age, gender, ethnicity, employment status, marital status, history of falls, exercise levels, and length of yoga participation. Demographic data were used to describe the study participants.

Activities-specific Balance Confidence (ABC) Scale

To determine an individual's self-perceived balance and fall efficacy, the ABC Scale was utilized. The ABC Scale (Powell & Myers, 1995) is a 16-item assessment tool where the individual can personally evaluate his or her level of confidence in performing specific balance tasks without experiencing a fall or feeling off-balance. The individuals answered each item using an 11-point scale that consists of whole numbers from 0-100%. To score the ABC Scale, an average of the individual's total responses is calculated. A score of 67 or less is predictive of falling for older adults (Powell & Myers, 1995).

The ABC Scale has strong validity and reliability when completed independently by the individual (Talley, Wyman, & Gross, 2007) and is better in detecting poor fall efficacy in older adults than the Falls-Efficacy Scale (Powell & Myers, 1995; Skalko, Sauter, Burgess, & Loy, 2013). Powell and Myers (1995) reported excellent test-retest reliability ($r = 0.92$) in the elderly population. The ABC Scale has an excellent internal consistency for community dwelling older adults with a Cronbach's alpha of 0.96 (Huang & Wang, 2009). Furthermore, it is concluded that the ABC Scale is appropriate for research emphasizing improved physical functioning (Powell & Myers, 1995; Talley et al., 2007).

The Multi-Directional Reach Test (MDRT)

The MDRT was used as a quantifiable measure to assess an individual's limit of stability, which is an indicator of overall balance (Newton, 2001). Using a yardstick up against a wall, the test measures how far an individual is willing/able to reach outside their base of support in four different directions: (a) forward, (b) backward, (c) left lateral, and (d) right lateral (Newton, 2001).

During the MDRT, participants were instructed to stand with their feet shoulder width apart, raise an arm in front of them at shoulder height parallel to the floor, and reach as far forward as they could without making contact with the yardstick or wall, and without moving their feet. Participants were asked to complete the same task in the remaining directions: backward (backward reach), left (left lateral reach), and right (right lateral reach). Each direction had three trials. The first was a practice trial for the individual to get familiar with the test, and the next two were recorded trials to calculate

an average score. The researcher measured the end of each reach on the yardstick at the middle finger location.

Although the MDRT has no definite cut-off scores for balance, Newton (2001) discovered the mean scores for each direction in older adults who reported tripping or falling in the past six months:

- Forward (in.): 8.38, SD 4.07
- Backward (in.): 4.06, SD 2.94
- Right (in.): 6.12, SD 2.76
- Left (in.): 5.67, SD 3.06

The MDRT has been established as a reliable and valid tool for assessing balance in the four different directions while experiencing an altered center of gravity (Newton, 2001; Holbein-Jenny et al., 2005). Newton (2001) reported statistically significant correlations for all the reaches ($p \sim .0004$) with the Berg Balance Test in community-dwelling older adults. Research also reports a strong international consistency, or Cronbach's alpha, between 0.80 (Holbein-Jenny et al., 2005), and 0.842 (Newton, 2001). Additionally, adequate construct validity ($ICC = 0.41-0.59$) was reported for each of the directions when compared to the ABC Scale (Holbein-Jenny et al., 2005).

Appendix E

Extended Results

This study investigated the relationship between levels of participation in yoga and balance measures of older adults. In the first set of analyses, descriptive frequencies were run on demographic variables to generate a profile of the sample population. Bivariate correlations were conducted to determine significant associations between the study variables. Finally, linear regression analyses were run to determine whether yoga variables predicted balance outcomes when controlling for significantly associated personal characteristics with the sample of adults.

Descriptive Analysis of Demographics

Table 1 displays the findings from the descriptive analysis. Data were collected and analyzed for the 52 study participants. The ages of the participants ranged from 55 years to 76 years, and the average age of participants was 63.7 years ($SD= 6.2$). The majority of the study participants were female (86.5%) and White/Caucasian (90.4%). Over half of the participants were retired (55.8%) from employment. Additionally, most of the participants were married (71.2%). When asked the question, “Are you afraid of falling?”, 19.2% of participants self-reported a fear of falling (FoF). When asked the question, “In the past 6 months did you experience a fall?”, 17.3% reported yes. Approximately 52% of participants had been practicing yoga for more than 2 years, 54% attended 0-6 sessions in the past 30 days, and 90% of all individuals participate in physical activities, other than yoga, two or more times a week. Participants’ average score on the ABC Scale was 92.16% out of a possible 100% ($SD= 9.9$). Additionally, participants’ average reach on the MDRT was: (a) forward= 14.5in. ($SD= 2.1$), (b)

backward= 10.1in. (SD= 2.9), (c) left lateral= 9.5in. (SD= 2.2), and (d) right lateral= 10.7in. (SD= 2.1).

Linear Regression of Yoga Variables on ABC Scale and MDRT

First, analyses were conducted to determine whether yoga variables (length of yoga participation and number of yoga sessions) significantly predicted performance on the ABC Scale and MDRT. The model for the ABC Scale was not significant ($F(2,48)= 0.27, p= 0.76$), and the regression analysis demonstrated no significant relationships between the scores on the ABC scale and the independent variables, number of yoga sessions ($b= 0.08, p= 0.58$) or length of yoga participation ($b= 0.05, p= 0.74$). (See Table 2).

The regression model for the forward reach of the MDRT was significant ($F(2,49)= 4.26, p= 0.02$) and, overall, 11% ($\text{Adj. } R^2= 0.11$) of the variance in the MDRT forward reach scores was accounted for by the independent variables included in this model. However, how long an individual had been engaged in yoga, ($b= 0.30, p= 0.03$) was the only variable that significantly predicted this measure of balance (See Table 3). The models examining performance on the backward, left, and right reach tests were not significant; neither number of yoga sessions nor length of yoga participation were significant predictors of balance on the backward, left, and right reach measures of the MDRT. (See Table 3).

Relationship Between Demographic Variables and Falls Measures

Since the regression analysis of the primary research questions found limited areas of significance, the descriptive statistics were used to explore correlational relationships between select independent variables and the dependent variables to

generate a more complete understanding of the relationship between yoga participation and balance measures (See Table 4). Table 4 shows the results of the correlational analysis of demographic variables and fall-related test measures results including the Activities-specific Balance Confidence (ABC) Scale and the Multi-Directional Reach Test (MDRT) scores.

Results indicated that gender and race/ethnicity were significantly associated with performance on the MDRT, in both the forward and backward direction. Specifically, females performed worse on these assessments than males. Participants who were Caucasian significantly outperformed non-Caucasians on the MDRT forward and backward reach. Individuals with a self-reported fear of falling (FoF) had significantly lower scores overall on the ABC scale than individuals with no self-reported FoF.

In the correlation analysis of the relationship between yoga participation variables and the falls measures, only overall length of yoga participation was significantly associated with the MDRT forward reach. As reflected in the regression analysis, individuals who had participated in yoga for a longer period of time performed better on the forward reach test.

Based on the correlation analyses, four variables (gender, race/ethnicity, fear of falling (FoF), and length of yoga participation) were identified and included as independent variables in a linear regression to predict ABC Scale and MDRT scores. While the number of yoga sessions was not found to be significant in the correlation analyses, it was included as a variable in the linear regression analyses since it was a primary variable of interest for this study.

Linear Regression of Balance Measures on Yoga and Physical Activity Variables

A second linear regression analysis was conducted that controlled for personal and demographic variables that were significantly correlated with the balance measures (i.e., gender, race, and FoF) in addition to the yoga and physical activity variables (i.e., number of yoga sessions, length of yoga participation, and physical activity). Table 5 displays the results from the linear regression used to examine whether the variables significantly predicted the participants' self-perceptions of balance as reported by the ABC Scale. The model was not significant ($F(7,43)= 1.44, p= 0.22$), but FoF was a significant predictor of scores on the ABC Scale. Individuals with a self-reported FoF had lower scores on the ABC Scale than those with no self-reported FoF(See Table 5).

Using the same factors as independent variables, separate regressions were utilized to explore the association between these variables and objective performance on each of the four directions of the MDRT (See Table 6). The model predicting adults' performance on the forward reach test was significant ($F(7,44)= 3.13, p= 0.02$) and accounted for 23.0% (Adj. $R^2= 0.23$) of variance in the MDRT forward reach scores. Gender ($b= -0.35, p= 0.01$) was the only significant predictor for scores on the forward reach test, and the findings suggested that females performed more poorly on the forward reach test than males.

The regression model predicting performance on the backward reach test was also significant ($F(7,44)= 4.68, p \leq 0.001$) and explained 34% (Adj. $R^2= 0.34$) of the variance in the scores on the backward reach. Physicalactivity ($b= 0.27, p= 0.03$), gender ($b= -0.49, p = 0.001$) and race ($b= 0.27, p= 0.036$) were all significant predictors. Adults who were Caucasian and reported engaging in greater amounts of physical activity

performed significantly better on the backward reach test, and females performed worse on this MDRT measure than males.

The regression models predicting adults' performance on the left reach test ($F(7,44)= 1.22, p= 0.31$) and the right reach test ($F(7,44)=0.85, p = 0.56$) were not significant. Additionally, none of the variables in these models appeared to be significant predictors of left or right balance.

The regression analysis of the yoga participants' measures on the MDRT identified the forward reach variable as the only statistically significant predictor in performance. To offer a more complete profile, descriptive statistics were used to explore correlational relationships between select demographic variables and yoga participation on balance measures. The correlation analyses provided greater understanding of variables that impact balance measures and offered additional information for future consideration in recreational therapy interventions. The more complete understanding of the relationship of yoga participation and other variables provides thought for future service delivery and recommendations for preventative services that may impact the functional performance of older adults.

Table 4.
Correlations of All Variables on ABC Scale and MDRT

	ABC Scale	MDRT Forward	MDRT Backward	MDRT Left	MDRT Right
Age	-0.75	0.17	0.06	0.05	0.07
Gender	-0.20	-0.45***	-0.54***	-0.13	-0.12
Married	0.04	-0.09	0.02	-0.00	-0.25
Race/Ethnicity	0.13	0.28*	0.29*	0.19	0.06
Retirement Status	0.05	0.16	0.11	0.05	0.24
Fear of Falling	-0.38**	-0.25	-0.17	-0.01	-0.06
Fall History	-0.11	-0.17	-0.21	0.00	-0.13
Yoga Session	0.10	0.26	0.22	-0.17	-0.10
Yoga Participation	-0.07	0.34*	0.17	-0.20	-0.17
Physical Activity	-0.10	0.11	0.21	-0.11	-.15

Note. * $p \leq .05$. ** $p \leq .01$, *** $p \leq .001$

Table 5.
A Linear Regression Model of All Variables on the ABC Scale

Variables	B	SEB	β
Gender	-3.12	4.11	-0.11
Race	1.52	4.89	0.05
Fall Fear	-9.23	3.63	-0.38*
Fall History	-2.83	3.68	-0.11
Yoga Sessions	0.05	0.23	0.03
Yoga Participation	-0.83	1.31	-0.10
PhysicalActivity	-0.97	1.43	-0.10
F		1.44	
Adj. R ²		0.06	

Note. * $p \leq .05$.

Table 6.
A Linear Regression Model of All Variables on the Multi-Directional Reach Test.

Variable	<u>Forward</u>			<u>Backward</u>			<u>Left</u>			<u>Right</u>		
	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β
Gender	-2.12	0.78	-0.35**	-4.12	1.00	-0.49***	-1.10	0.91	-0.18	-0.71	0.90	-0.12
Race	1.28	0.92	0.19	2.58	1.19	0.27*	1.93	1.09	0.27	0.46	1.07	0.07
Fall Fear	-0.47	0.68	-0.09	-0.30	0.88	-0.04	-0.20	0.81	-0.04	-0.57	0.79	-0.11
Fall History	-0.26	0.69	-0.05	-0.42	0.90	-0.06	-0.06	0.82	-0.01	-0.93	0.81	-0.17
Yoga Sessions	0.03	0.04	0.10	0.03	0.06	0.07	-0.07	0.05	-0.21	-0.04	0.05	-0.11
Yoga Participation	0.28	0.25	0.16	-0.14	0.32	-0.05	-0.48	0.29	-0.25	-0.42	0.29	-0.23
Physical Activity	0.25	0.27	0.12	0.77	0.35	0.27*	-0.03	0.32	-0.01	-0.29	0.31	-0.14
F		3.13**			4.68***			1.22			0.85	
Adj. R ²		0.23			0.34			0.03			-0.02	

Note: * $p \leq .05$. ** $p \leq .01$, *** $p \leq .001$.

Appendix F

Extended Discussion

Current literature, although abundant with research of functional gains produced through yoga, is deficient of research exploring the relationship between one's level of yoga participation and measures of balance. Therefore, the purpose of this study was to determine if relationships exist between levels of participation in yoga (i.e., overall lifetime engagement and number of sessions attended in the last 30 days) and balance measures of older adults. While this study demonstrated that the length of time an individual had participated in yoga significantly predicted balance, in terms of their ability to reach forward, no other significant findings were noted with the variables of interest. However, the results do encourage further discussion and investigation to better determine if yoga can be used as an alternative therapeutic intervention for the elderly population. Specifically, it may be possible to improve balance measures and produce better results through a prescribed protocol or by making adjustments in the frequency of participation, the intensity of participation, and the duration of participation in yoga.

The analysis of the 52 older adult participants indicated that overall lifetime engagement in yoga was a significant factor in predicting scores on the forward reach of the MDRT. It was demonstrated that as one's overall lifetime engagement in yoga increased so did his or her performance on the forward reach balance measure of the MDRT. Yogafit® founder and author, Beth Shaw (2009), reports that of all the yoga poses (asanas) practiced, individuals are most familiar with forward bending ones (p. 104). She reports that most of forward bending in daily life uses poor body mechanics by

bending through the spinal cord and rounding the shoulders. Yoga teaches individuals to bend by hinging from the hips with a straight spine in order to prevent falls and injuries.

The Social Cognitive Theory (SCT) suggests that perceived self-efficacy is the core determinant for whether an individual will continue to participate in an activity or not. Thus, individuals who believe they have the capability to achieve the desired outcomes (i.e., self-efficacy) will strategize and implement behaviors as necessary to produce the desired effects (Bandura, 1998). In turn, self-efficacy is particularly important in an individual's initial adoption of an exercise program (Taylor, 2014) because the individual may self-select activities that he or she feels confident about or are good at for participation. Therefore, introducing activities, such as yoga, at an earlier stage in life may promote increased self-efficacy, which may then encourage greater participation and thus, improve functional gains for the elderly population.

In this study, while lifetime participation patterns significantly predicted performance in the forward reach, it is unknown if specific asanas can produce positive gains in the other measures of balance of the MDRT or even one's self-efficacy measured by the ABC Scale. While yoga involves a wide range of protocols including various asanas for developing functional outcomes, the results suggest that future research evaluate specific yoga protocols in order to determine those asanas that produce the most effective gains in functional outcomes on each reach measure of the MDRT. These protocols would include some measures of the frequency, intensity, and duration of participation in order to produce the desired outcomes. Recreational therapy professionals in both prevention and active treatment services can then prescribe the most effective approach for developing competencies in distinct directional measures of balance.

In the current study, significant results on the relationship between participants' balance measures and either their lifetime patterns of yoga engagement or their current yoga practices were limited. While many of the research studies involving yoga report positive results, the lack of a clear and standard definition for "participation in yoga" affects current research findings because "...there is no evidence for determining dose, frequency, and duration for the most effective yoga program" (Zettergren et al., 2011, p. 93). If future research could determine a set dosage of yoga participation in order to achieve improved functional outcomes such as balance, the results could have a significant impact on the provision of both therapeutic and preventative yoga services in recreational therapy practice. Recreational therapy professionals may, therefore, encourage greater engagement of both young and elderly clients to participate in yoga as an alternative therapeutic intervention in producing desired functional outcomes.

This study also demonstrated that older adults who self-reported a fear of falling (FoF) displayed significantly lower overall scores on the ABC scale than those without the self-reported fear. Current literature suggest that older adults who have a FoF may avoid or restrict their participation in certain activities that require balance because their balance impairment affects their ability to perform activities related to balance (Huang, Chi, & Hu, 2013). In turn, older adults with a FoF may be less likely to engage in a yoga class even though incorporating functional balance tasks into interventions such as yoga has the potential to benefit the older adult with a FoF (Huang et al., 2013). However, this study did not reveal an association between FoF and levels of physical activity. In fact, 19% of this study sample reported a FoF, while other studies have reported 35-47% of

community-dwelling adult share this fear (Allison et al., 2013; Arnold & Faulkner, 2007; Hornyak et al., 2013).

Since the study produced limited significant results on the relationship of yoga participation and balance, other demographic variables were explored (i.e., age, gender, ethnicity, and physical activity). The inclusion offered additional insights into those variables that may predict an influence on balance among adults who participate in yoga.

As reflected in prior research, females in this study were overall less active than men. The Centers for Disease Control and Prevention (2014b) report that women, in every age group, are less likely to achieve the recommended amounts of physical activity compared to men. The U.S. Department of Health and Human Services (2008) state that low levels of physical activity in older adults are associated with higher risks of developing serious and chronic health conditions, as well as an increased risk of mortality. As supported by the literature (Allison et al., 2013; Hornyak et al., 2013; Taylor, 2014; WHO, 2010), physical inactivity can significantly and negatively impact the overall physical functioning of an individual.

Surprisingly though, the most recent “Yoga in America” survey (2012) reports that 82.2% of yoga participants are female. In our study, the sample population was also heavily female driven (86.5%). However, when analyzing if gender was a predictor of balance performance, the results indicated that females performed significantly lower than males on the forward and backward reach of the MDRT. Although the majority of participants in yoga tend to be female, the results suggest that women can increase their forward reach performance by participating in yoga from an earlier age and thus having a longer length of yoga participation over time.

Physical activity was also found to be a significant predictor in scores on the backward reach of the MDRT, indicating that individuals who engage in greater amounts of physical activity performed better on this objective measure than those who were less active. The United States Department of Health (2008) states, "... most health [benefits] occur as the amount of physical activity increases through higher intensity, greater frequency and/or longer duration" (p. 8). Therefore, it may be possible for both women and men to acquire functional improvements in the backward reach of the MDRT by increasing their level of participation in physical activities including yoga.

According to The Centers for Disease Control and Prevention (2014b), Caucasian adults are more likely to meet the 2008 Physical Activity Guidelines than non-Caucasian adults. In the current study, older adults who were Caucasian performed significantly higher on the forward and backward reach of the MDRT than non-Caucasians. Although the ethnic representation in the current study was primarily Caucasian and there was an association between ethnicity and two of reaches of the MDRT (i.e., forward and backward), further research with a greater ethnic representation would need to determine if this association is primarily due to yoga or not.

In this study, about half of the participants were retired. Older adults who are still employed may have restricted participation in yoga based on class availability as compared to retired individuals. At the facilities chosen for this study, many of the yoga classes (specific to older adults) were offered in mornings and early afternoons. For an employed older adult, these available class times may conflict with his or her work schedule and discourage him or her from actively engaging in yoga. Conceivably, if more

available times throughout the day were offered specifically for older adults, there may be a subsequent increase in yoga participation.

Although there may be a wide range of barriers to participation in yoga and other forms of physical activity, there are equally a number of facilitators to participation. The Centers for Disease Control and Prevention (2011) state many personal variables including behavioral, psychological, physiological and environmental factors, affect an individual's plan to become more physically active. Barriers may include a lack of confidence in their ability (i.e., low self-efficacy), fear of being injured, lack of social support, low discretionary income, limited availability of transportation, and lack of resources/facilities. Hence, continuing efforts to create systems that are responsive to the needs of older adults for increased physical activity are needed. While this research did not answer these questions, the outcomes of this study did provide some support for the continued engagement of older adults in preventative and intervention based physical activity such as yoga to improve balance.

Limitations

We recognize several limitations to this study. The use of a cross sectional studies design required all participants to be measured only once at a specific time point. A cross sectional studies research design poses limitations including the absence of a control group and the lack of evaluation of casual relationships between variables.

This study employed a non-randomized purposive sampling to gather participants. Specific inclusion criteria (e.g., age and yoga participant) were mandatory for inclusion in the study. The chosen sampling approach led to an under-representation of males and non-Caucasian individuals in the sample population. In addition, thirty participants were

aged 55-64 years old, twenty aged 65-74 years, and only two participants were 75 years and older. Thus, the effect of yoga participation on balance among adults aged 75 years and older requires additional investigation.

Perhaps the inclusion of adults from 55-64 years old and already active in yoga resulted in an atypical “older adult” population. Approximately 91% of participants in this study reported participating in physical activities two to seven times a week, which meets the WHO’s *Global Recommendation on Physical Activity for Health* and may represent a more healthy and active sample than other studies with a minimum age requirement of 65 years.

Our study sample had fall characteristics that were not very similar to those reported throughout the literature. The CDC (2013) reported that one in three older adults will experience a fall each year. In this study, 17.3% of the sample reported experiencing a fall in the past six months, which differs from previous research in which the sample population experiencing a fall ranged from 35%-47% (Allison et al., 2013; Arnold & Faulkner, 2007; Hornyak et al., 2013). In this study of 52 participants, 19.2% (n=10) reported a FoF. While this study did not address the percentage of participants that had fallen and reported a FoF, previous research states that 40-73% of individuals who have fallen (Jung, 2008) and 20-46% of individuals who have not fallen (Schmid et al., 2010) will possess a FoF.

Due to the majority of our sample being individuals who never experienced a fall and have no self-reported FoF, the relatively high mean scores on the ABC Scale and each directional reach of the MDRT were not surprising.

Conclusion

Although, this study demonstrated limited areas of significance for levels of participation in yoga and balance measures of older adults, it revealed some areas of importance and possible ideas for further research on yoga. It is recommended that future research continue to examine the frequency, intensity and duration of yoga practice for an effective program with this population, and utilize a larger sample of adults with no experience in this activity to better assess its effect on balance.

Future research should also examine the most effective asanas to produce functional balance outcomes for the elderly population. Based on the results of this study, yoga may be a potential intervention for adults who need to improve their performance on forward reach measures. Given the extensive research on yoga, it is evident that it has the potential to increase older adults' performance on functional balance outcomes and could be used as an alternative therapy intervention to improve balance impairments.

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