THESIS

YOGA IMPROVES BALANCE, BALANCE CONFIDENCE, AND OCCUPATIONAL PERFORMANCE FOR ADULTS WITH DIABETIC PERIPHERAL NEUROPATHY: A PILOT STUDY

Submitted by

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ABSTRACT

YOGA IMPROVES BALANCE, BALANCE CONFIDENCE, AND OCCUPATIONAL PERFORMANCE FOR ADULTS WITH DIABETIC PERIPHERAL NEUROPATHY: A PILOT STUDY

The purpose of this study was to examine the preliminary efficacy of yoga on balance, balance confidence, occupational performance, and satisfaction with performance in adults with diabetic peripheral neuropathy (DPN).

We used a non-controlled pretest-posttest design.Fifteen adults with DPN attended 8-weeks of yoga, including positive affirmations, breathing, postures, and relaxation. Balance was measured using the Berg Balance Scale (BBS); balance confidence, using the Activities-specific Balance Confidence Scale (ABC); and perceived occupational performance and satisfaction, using the Canadian Occupational Performance Measure (COPM).

Significant improvements were found for balance (p=.009), balance confidence (p=.004), occupational performance (p=<.001), and satisfaction with performance (p=<.001). Improvements remained significant after theBonferroni correction (α= .05/4- .0125). The effect sizes were medium for balance (d_{Cohen} = 0.65) and large for occupational performance and satisfaction (d_{Cohen} = 1.13, 1.07, respectively).

Yoga appears to significantly improve balance, balance confidence, occupational performance, and satisfaction for adults with DPN. Further research utilizing a control group, a larger sample size, and randomization is required.

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TABLE OF CONTENTS

LIST OF KEYWORDS AND DEFINITIONS

Balance

"Human balance is a multidimensional concept, referring to the ability of a person not to fall" (Pollock et al., 2000).

Balance Confidence

Balance confidence is a person's self-efficacy or self-confidence in their ability to balance (Powell et al., 1995).

Complementary and Alternative Medicine (CAM)

"A group of diverse medical and health care systems, practices, and products that are not generally considered part of conventional medicine" (National Center for Complementary and Alternative Medicine, 2008).

Diabetes

Diabetes is a complex metabolic disorder that causes high blood glucose or hyperglycemia with a variety of causes. The three main types of diabetes are: 1.) Type 1 diabetes; 2.) Type 2 diabetes; 3.) Gestational diabetes. Type 1 and type 2 diabetes will be discussed in this paper(NIDDK, 2011).

Diabetic Peripheral Neuropathy

DiabeticPeripheral Neuropathy (DPN), is "the presence and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes" (Boulton et al., 1998).

Fear of Falling

Fear of Falling (FoF) is "a fear occurring over a period of time and a lasting concern about falling related to a loss of confidence in balance and mobility often related to an avoidance of activities that stroke survivors could be capable of performing" (Schmid et al., 2011, p. 46).

Hatha Yoga

The most common type of therapeutic yoga used in Western cultures is hatha yoga, which incorporates physical postures (asanas), breath (pranayama), and meditation(Collins, 1998).

Occupational Performance

Occupational Performance "is the act of doing and accomplishing a selected action (performance skill), activity, or occupation and results from the dynamic transaction among the client, the context, and the activity" (AOTA, 2014, p.S14).

Participation

Participation is "engagement in desired occupations in ways that are personally satisfying and congruent with expectations within the culture" (AOTA, 2014, p. S35).

Type 1 Diabetes

Type 1 diabetes, formally called juvenile diabetes, is caused by the immune system attacking and destroying the beta cells in the pancreas, causing dysfunction. They no longer produce insulin leading to high blood sugar (NIDDK, 2011).

Type 2 Diabetes

Type 2 diabetes, formerly called adult onset diabetes, is caused by insulin resistance related to excess weight, in which the muscle, liver, and fat cells do not use insulin properly. The pancreas lose the ability to produce enough insulin and blood glucose levels rise (NIDDK, 2011).

Yoga

Yoga is the combination of breathing exercises, physical postures, and meditation to calm the nervous system and balance the body, mind, and spirit (Barnes et al., 2008).

LIST OF ABBREVIATIONS

ABC	Activities-specific Balance Confidence Scale
AOTA	American Occupational Therapy Association
BBS	Berg Balance Scale
CAM	Complementary and Alternative Medicine
DM	Diabetes Mellitus
DPN	Diabetic Peripheral Neuropathy
FAB	Fullerton Advanced Balance Scale
FoF	Fear of Falling
ICF	International Classification of Functioning, Disability, and Health
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
OT	Occupational Therapy
OTR	Occupational Therapist
QoL	Quality of Life
SPSS	Statistical Package for the Social Sciences

CHAPTER 1: INTRODUCTION

1.1Purpose

The purpose of this study was to examine the preliminary efficacy of a group yoga intervention on balance, balance confidence, and occupational performance and satisfaction with performance in adults with Diabetic Peripheral Neuropathy(DPN).

1.2 Background and Statement of Problem

Diabetes Mellitus (DM) is a chronic, lifelong condition that affects the body's ability to use glucose. In the United States, DMeffects nearly 29.1 million people, accounting for about 9.3% of the national population (Center for Disease Control and Prevention, 2014).Of those people, 50% have some degree of peripheral neuropathy (Gordois et al., 2003; National Institute of Diabetes and Digestive and Kidney Diseases, 2011). Diabetic Peripheral Neuropathy (DPN) is the manifestation of symptoms and/or signs of peripheral nerve dysfunction in the hands, arms, feet and/or legs (Boulton, 2005; Gordois et al., 2003). The feet and legs are typically affected prior to the arms and hands.

DPN may cause the followingsymptoms: hypersensitivity to pain or touch; pain or cramps; a tingling, burning or prickling sensation;and loss of sensations including proprioception, vibration, touch and temperature (Azhary et al., 2010; DiBonaventura et al., 2011; Gordois et al., 2003; Li et al., 2010; National Diabetes Information Clearinghouse, 2013). These symptoms negatively impact one's life as they are associated with depression, sleep disturbances, progressive muscle weakness, chronic pain, decreased mobility, loss of occupational engagement, balanceproblems, and decreased quality of life(Argoff et al., 2006; Textor et al., 2012). Additionally, people with DPN are susceptible to medical complications such as foot ulcers and amputations, which incur great costs, estimated to be $10.91 billion

(Gordois et al., 2003). The growing prevalence of DPN has huge implications for occupational therapy (OT) in various settings as practitioners play a valuable role in promoting health and preventing chronic disease and disability through participation in meaningful occupations (Gupta et al., 2015).

For this thesis, I focused on three factors that impact ones performance and participation in meaningful daily occupations and their quality of life: 1.) balance, 2.) balance confidence, 3.) individual perception of occupational performance and satisfaction with performance. In the following paragraphs, I will review these factors as well as discuss related past and present research.

Researchers have identified balance and balance confidence as major problems faced by those who experience DPN (DiBonaventura et al., 2011; Kruse et al., 2010; Li et al., 2010; Richardson et al., 1996). Human balance is "a multidimensional construct, referring to the capacity of a person not to fall" (Pollock et al., 2000, p.405).Balance Confidence is defined as a person's self-efficacy or self-confidence in their ability to balance (Powell et al., 1995). Decreased balance is a consequence of DPN related somatosensory impairment. As a result of decreased balance, people with DPN are predisposed to falls, which can lead to injury, decreased balance confidence, fear-related avoidance of activities, and decreased quality of life (Delbaere et al., 2004; Friedman et al., 2002; Richardson et al., 1996). Thus, one enters into a vicious cycle, where one problem exacerbates the other, and individuals are faced with occupational deprivation and poor quality of life (Whiteford, 2000).

While falls are not the main focus of this paper, it is important to acknowledge falls as they are the leading cause of both fatal and nonfatal injuries among older adults and are prevalent among individuals with DPN (Centers for Disease Control and Prevention, 2013; Richardson et

al., 1995). In older adults, falls occur in 1 out of 3 people (age 65 and older) each year and of those individuals who sustain a fall, 90% develop a fear of falling, which in this paper, I will describe as decreased balance confidence (Chandler et al., 1996; Murphy et al., 2002; Schmid et al., 2010). People with DPN are at an even higher risk for falling due to sensory and motor nerve impairments (Kruse et al., 2010; Pollock et al., 2000; Richardson et al., 1992; Richardson et al., 1995).With over 10.9 billion older adults (over age 65) currently living with DPN, and an expectation that this prevalence will increase due to an increasing number of people with DM, it is essential to research interventions that prevent falls (NIDDK, 2011). In conclusion, to obstruct continuation of the vicious cycle of decreased balance, falls, decreased balance confidence, injury, and decreased participation in meaningful occupations, it is important that occupational therapists (OTRs) choose interventions that address balance and balance confidence when working with people with DPN, as improvements are likely to lead to increased participation in daily life activities.

Meaningful participation in occupations has been shown to positively influence health and well-being(Yerxa et al., 1990). However, people with DPN report that they no longer participate in their preferred meaningful activities due to both physical and psychological factors (Fisher et al., 2007). While OTRs cannot change past life experiences that come to frame one's perception of their present situation, OTRs can provide opportunities for people with DPN to experience positive emotions through competence or self-efficacy, which can influence value and belief systems. Positive emotions and experiences can lead to improved health and well-being and instill motivation for future participation in occupation (Eakman, 2015; Fisher et al., 2007).

Currently, medical treatment for DPN focuses on bringing glucose levels into a normal range. According to the NIDDK, the following interventions can help control glucose levels: glucose monitoring, meal planning, physical activity, and diabetes medicine or insulin (NIDDK, 2011). Yoga, a mind/body practice, is one option under the category of physical activity.

While no researchers have investigated the efficacy of yoga for people with DPN, researchers have investigated the use of Tai Chi, which is a similar mind/body practice. Li & Manor (2010) explored the efficacy of 24-weeks of Tai Chi on strength, balance, and plantar sensationfor 25 adults with peripheral neuropathy. While they found significant improvements in strength and sensation, they did not find significant changes in balance. Additionally, the researchers did not investigate the impact of Tai Chi on performance and participation in daily occupations, which is said to be the ultimate measure of effectiveness (Baum, 2011).Barnes and her team reported on the estimates of Complementary and Alternative Medicine use among US adults from a 2007 Health Survey(Barnes et al., 2008). Yoga was used at a rate almost six times that of Tai Chi. Due to many more adults in the United States (US) using yoga, yoga may be a more familiar and accessible mind/body intervention.

Yoga has been shown to provide favorable results for people with DM and other chronic conditions including stroke, chronic heart failure, and COPD (Bernardi et al., 2002; Raupach et al., 2008; A. A. Schmid et al., 2012). Malhorta et al. (2002) studied the efficacy of 40 days of 30-minute yoga sessions on nerve conduction velocity and basal blood glucose for people with Type 2 DM. The intervention group showed improvements in nerve function and glycemic controland the nerve function in the control group deteriorated.. Further, yoga might be an effective tool for people specifically with DPN as past research has revealed that yoga improves co-morbidities associated with DPN including: muscular strength; balance; balance confidence; sleep patterns;

QoL; depression; and pain (Woodyard, 2011). Schmid et al. (2012) found that balance and balance confidence are associated with activity and participation in people with stroke. It is possible, therefore, that increased balance and balance confidence will similarly lead to increased occupational performance for people with DPN, as both stroke and DPN are chronic conditions affecting balance and occupational engagement. Lastly, yoga is accessible due to the growing number and types of available classes in emerging yoga studios, community centers, and hospitals (Barnes et al., 2004).

Therefore, this pilot study aims to investigate the effects of yogaon balance, balance confidence, and perceived occupational performance for people with DPN.

1.3 Research Questions

1. Do balancescores increase after 8 weeks of yoga for people with DPN?
2. Do balance confidence scores increase after 8 weeks of yoga for people with DPN?
3. Is there an increase in occupational performance and satisfaction with performance scores as measured by the Canadian Occupational Performance Measure (COPM) after 8 weeks of yoga in people with DPN?

CHAPTER 2: REVIEW OF THE LITERATURE

2.1 Introduction

In the following section I will introduce the conceptual framework that guided my thesis. Then I will provide definitions, incidence, and prevalence information for DM and DPN. Next, I will discuss how DPN impacts the daily life of individuals affected. More specifically, I will discuss balance, balance confidence, the vicious cycle, and occupational performance and participation. Therapeutic yoga will then be introduced as a potential intervention for the DPN population. Finally, I will discuss implications for occupational therapy.

2.2 Conceptual Framework

The conceptual framework guiding this research is the World Health Organization, International Classification of Functioning, Disability, and Health (ICF)'s conceptual

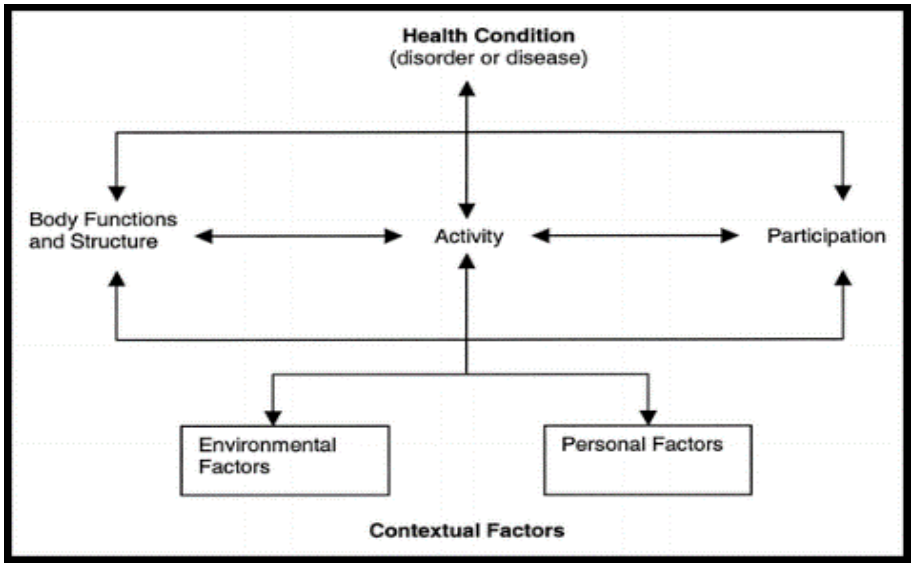

Figure 1: ICF Conceptual Framework(World Health Organization, 2001)

framework(World Health Organization, 2001). As shown in figure 1, the domains of the ICF

include: health conditions, body functions and structure, activity, participation, and environmental and personal factors. The following definitions are pulled directly from the ICF (World Health Organization, 2001). Body functions are "physiological or psychological functions of the body systems" (i.e. balance). Body structures are the "anatomical parts of the body such as organs, limbs, and their components." Activity, the "execution of a task or action by an individual," includes self-care and general tasks. Participation, or "involvement in a life situation," includes: domestic life, interpersonal interactions, and involvement in community, social, and community life. Lastly, environmental factors are "the physical, social and attitudinal environment which people live and conduct their lives." The bi-directional arrows indicate that all of the domains are interrelated and impact one another.

For this study I am concerned with changes in body function (balance), personal factors (balance confidence, perceived occupational performance, and satisfaction with performance), and activity and participation (occupational performance) as changes in these domains, according to this framework, will directly impact health.

2.3 Diabetes Mellitus (DM)

Definition and Prevalence

DM is a complex metabolic disorder that causes high blood glucose or hyperglycemia with a variety of causes. The three main types of DM are: 1) type 1 diabetes; 2) type 2 diabetes; 3.) gestational diabetes (NIDDK, 2011). In the United States, DMeffects nearly 29.1 million people, accounting for about 9.3% of the national population (CDC, 2014). The prevalence of type 2 DM is expected to increase as a larger proportion of the population remains overweight and as the United States population ages (NIDDK, 2011). It is estimated that 50% of people with DM have some degree of peripheral neuropathy, caused by nerve damage (Gordois et al., 2003; National Institute of Diabetes and Digestive and Kidney Diseases, 2011).

2.4 Diabetic Peripheral Neuropathy (DPN)

Definition

DPN is "the presence and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes" (Boulton et al., 1998). Over time, damage to the axons and/or myelin of peripheral nerves (sensory and motor nerves) can result in abnormal nerve conduction and/or spontaneous activity in the arms, hands, legs and feet(Azhary et al., 2010). The feet and legs are typically affected prior to the arms and hands(Argoff et al., 2006). DPN may cause the followingsymptoms: hypersensitivity to pain or touch; pain or cramps; a tingling, burning or prickling sensation;loss of sensations including proprioception, vibration, touch and temperature; strength loss, a decrease in mobility; and loss of balance and coordination (Azhary et al., 2010; Boulton, 2005; DiBonaventura et al., 2011; Gordois et al., 2003; Li et al., 2010; National Diabetes Information Clearinghouse, 2013). Symptoms vary from person to person and not all people who have nerve damage have symptoms (National Diabetes Information Clearinghouse, 2013). A predominant feature of DPN is sensory loss, causing a decrease in mobility,reduced or absent ankle reflexes, and loss of balance and coordination. These symptoms negatively impact one's life as they are associated with depression, sleep disturbances, progressive muscle weakness, chronic pain, loss of occupational engagement, and decreased quality of life(Argoff et al., 2006; Textor et al., 2012).

Incidence and Prevalence

Peripheral neuropathy is the most common type of diabetic neuropathy (National Diabetes Information Clearinghouse, 2013).The risk of developing DPN as a result of diabetes increases with age and longer duration of diabetes; the highest rates of DPN occur in people who have had diabetes for over 25 years(Boulton, 2005; National Diabetes Information Clearinghouse, 2013). DPN can occur in people with type 1 or type 2 diabetes, with 92.5% of

DPN resulting from type 2 (Gordois et al., 2003). Treating DPN and its symptoms can incur large annual costs estimated to be $237 million annually. Complications from DPN, including foot ulcers and amputations, incur even great costs, estimated to be $10.91 billion annually (Gordois et al., 2003).

2.5 Impact of DPN on Daily Life

DPN and Balance

"Human balance is a multidimensional concept, referring to the ability of a person not to fall" (Pollock et al., 2000, p. 405). To prevent falling, the human body inherently senses a threat to stability and uses muscular activity to counteract the force of gravity (Horak, 1987). Pollock et al. (2000) call this ability "balance or postural control"(Pollock et al., 2000). Balance includes both reactive (compensatory) and predictive (anticipatory) strategies (Pollock et al., 2000). If a person experiences dysfunction in the ability to maintain, achieve, or restore a state of balance, they are considered to have a deficit. (Horak et al., 1997).People with DPN often have balance problems due to somatosensory impairments (Richardson et al., 1996).

Kruse, LeMaster, and Madsen (2010) completed a 12-month randomized control trial for 79 people with DPN, comparing a home-based leg strength, balance, and graduated self-monitored walking intervention with a control group (motivational phone calls). The researcher's objective was to determine if the strength, balance, and walking intervention would decrease fall rates in people with DPN. They found that there was not a significant reduction in falls or an increase in balance and/or strength after the 12-month intervention for both groups. However, they did note that physical activity interventions did not INCREASE falls for people with DPN. Based on these findings, they recommend a supervised, community-based group exercise program as opposed to self-administered, home-based program to increase in-person contact between participants and staff and increase the effectiveness of the intervention.

In a review of interventions addressing balance problems for people with DPN, Ites et al. (2011) found that lower extremity exercise, in comparison to monochromatic infrared energy therapy, vibrating insoles, anduse of a cane, was the only intervention found that could be supported with research evidence to treat balance dysfunction in patients with DPN. One of the articles reviewed, Richardson et al., (2001) found that after 3 weeks of lower extremity exercises, the intervention group showed significant changes in tandem stance, single-leg stance, and functional reach scores. However, in the same group, there were no significant changes in balance confidence. The take-home message of Ites et al. (2011) review is that there is a significant need for further research to investigate the effectiveness of interventions to improve balance and balance confidence in patients with DPN.

One study, not included in Ites et al.'s review, investigated the efficacy of a mind/body practice, Tai Chi, on functional gait, strength, and plantar sensation for people with DPN (Li et al., 2010). The Tai Chi intervention included three, one-hour group sessions per week for 24 weeks and consisted of rhythmic movements, meditation, and breathing.Results indicated that functional gait, strength, and plantar sensation significantly improved after the Tai Chi intervention. Considering the significant improvements in functional gait, strength, and plantar sensation, it is surprising that balance did not improve. Due to similarities in Tai Chi and Yoga (both combine focused body movements, breathing, and meditation), yoga is likely to be a safe and effective intervention for this population. Yoga may potentially be a better option due to greater accessibility and popularity in the United States; Barnes et al. (2008) report that 6.1% of the U.S. population have experience with yoga and only 1.0% have experience with Tai Chi.

DPN and Balance Confidence

Balance confidence is a person's self-efficacy or self-confidence in their ability to maintain balance (Powell et al., 1995). Bandura's theory of self-efficacy states that one's

perception of his or her capabilities (whether accurate or not) will influence whether an individual will decide to engage in their daily life activities (Bandura, 1991). In a survey of 252 people with DPN (mean age 76 years), 66% reported that they feared they would fall when walking (Powell et al., 2006), which demonstrates decreased balance confidence.Decreased balance confidence is a problem as it is associated with activity restriction, anxiety, depression and decreased quality of life (Murphy et al., 2002; Schmid et al., 2011).

Richardson et al. (2001) measured balance confidence in a group of 20 individuals with DPN before and after a focused distal strength and balance exercise regimen. Although the intervention group demonstrated some improvements in balance confidence scores, as measure with the Activities-specific Balance confidence (ABC) scale (80±21 vs 88±11), they were not significant. Due to the psychological nature of balance confidence, a mind-body intervention, such as yoga, may be a more effective intervention.

DPN and Occupational Performance and Participation

Symptoms of DPN interfere with occupational performance and participation. DPN related symptoms can diminish interpersonal relationships, work, social activity, and physical activity (Textor et al., 2012). One symptom, chronic pain, which affects about 50% of individuals with DPN (Poliakov et al., 2011), has a significant negative impact on occupational performance. The stress, anxiety, depression, and fear associated with pain interferes with all occupations across a person's day, including self-care, family, spirituality, and work, leading to decreased QoL. Fisher et al. (2007) completed a qualitative study exploring the relationship between chronic pain and occupation. Results indicate that when meaningful and pleasurable occupational engagement increase, pain often decreases. Yoga, a gentle mind/body intervention, may offer a pleasurable and relaxing experience to reduce stress, depression, pain, and anxiety (Woodyard, 2011) and therefore improve meaningful occupational engagement.

The Vicious Cycle

People with DPN are at risk of entering into what Delbaere et al. (2004) describe as a 'vicious cycle.' Due to balance impairments, people with DPN are at risk for falls (Richardson et al., 1996). Falls, in turn can lead to injury, decreased balance confidence, and decreased participation in daily activities. Completing, and thus perpetuating the cycle, decreased participation can lead to decreased strength, flexibility, and balance. With over 10.9 billion older adults (over age 65) currently living with DPN, and an expectation that this prevalence will increase, it is essential to obstruct continuation of the cycle. One way to counteract decreased balance confidence and avoidance behaviors is to improveperformance skills and balance confidence(Murphy et al., 2002).

2.6 Therapeutic Yoga

Yoga is a 5000 year old eastern discipline that includes a combination of breathing exercises, physical postures, and meditation. Engaging in yoga calms the nervous system and balances or unites the mind, body, and spirit (Barnes et al., 2004; Raub, 2002). It has become increasing popular in the United States, with a prevalence of 6.1% or 13.2thousand adults having some experience with it (Barnes et al., 2008).

Therapeutic yoga is an emerging area of interest in the medical community and is often defined as the application of yoga postures and practice for health benefits or treatment of health conditions (Bastille et al., 2004; Collins, 1998; Feuerstein, 1998; Tatum et al., 2011). Yoga can provide a more holistic approach than traditionalmedical and pharmacological treatmentsbecauseit addresses the mind, body, and spirit(Collins, 1998). Therapeutic yogacan be utilized to: reduce stress; lower blood pressure; and improve coordination, flexibility, concentration, sleep, and digestion (Barnes et al., 2004). As an intervention, yoga has yielded significant benefits for various populations, including: healthy young adults; adults with chronic

stroke; COPD; Parkinson's disease; and PTSD (Hall et al., 2011; Hart et al., 2008; Raupach et al., 2008; A. A. Schmid et al., 2012; Telles et al., 2010). While previous research demonstrates the positive effect of yoga on various populations, researchers have not yet investigated the efficacy of yoga for people with DPN.

2.7 Implications for Occupational Therapy

The goal of occupational therapy (OT) is to facilitate participation and performance in meaningful occupations of daily life to promote health and well-being. A change in body function and structure, personal factors, and/or environmental factors can disrupt health and well-being. Occupational therapy's unique approach can address disruptions in health with a holistic view encompassing the person, the environment, and their occupation (Brown, 2014). The Occupational Therapy Practice Framework outlines potential outcomes for practice including, but not limited to: participation; health and wellness; prevention; quality of life; and adaptation (AOTA, 2002). All of these outcomes are affected by not only the physical body, but also by the psychological and spiritual aspects the person. Yoga takes a similar approach as it integrates physical, mental and spiritual aspects of the person. In today's literature, occupational scientists are advocating for yoga in areas of mental health, psychospiritual integration, and as an avenue for prevention (Mailoo, 2005; Telles et al., 2010). Yoga can also be used to facilitate relaxation and/or as a tool for performance and participation through breathing (pranayama) and meditation (self-discipline of the mind) (Mailoo, 2005). Yoga can be utilized in many ways within the scope of occupational therapy and more research should be done to establish evidence for its implementation.

2.8 Conclusion

DPN, a secondary condition to diabetes, is growing as a result of the growing number of people with diabetes. Symptoms of DPN can increase the risk for falling and balance problems, leading to decreased balance confidence.Additionally, people with DPN experience limitations in social participation, work, and other important daily activities due to pain, anxiety, depression, and sleep disturbances, leading them to have poor QoL. These issues, in other populations, have improved with therapeutic yoga. To my knowledge, no one has studied the efficacy of yoga in people with DPN. Therefore, the objectives of my study are to determine if therapeutic yoga improves balance, balance confidence, and occupational performance in people with DPN.

CHAPTER 3: METHODS

3.1 Design

This study was an uncontrolled, pretest-posttest pilot study to explore yoga as a potential intervention for balance, balance confidence, occupational performance, and satisfaction with performance among adults with DPN. Data were collected before and after an 8-week group yoga intervention.

3.2 Recruitment and Participants

We used a convenience sample, recruited over 3 months, from the Northern Colorado community. Participants were recruited through Colorado State University (CSU) Institutional Review Board (IRB) approved flyers, local hospitals, community centers, diabetes support groups, and diabetes resources fairs. IRB approval was obtained from CSU and participant consent was obtained prior to the commencement of the study. Inclusion criteria included: self-report of diabetic peripheral neuropathy (DPN); able to speak and understand English; scored a >4 out of 6 on the short 6 item Mini-Mental State Examination; and agreed to commit to assessments and 16 sessions of yoga. Potential participants were excluded if: they self-reported that they consistently engaged in yoga for over a year; reported a terminal illness with life expectancy of < 6 months; and/or if they were unable to secure transportation to the sessions.

3.3 Outcome Measures

Data were collected by a trained research assistant and included basic demographics and DPN characteristics; including: age; race; gender; time since DPN onset; type of diabetes (pre-diabetes, type I, or type II); and location of symptoms. DPN severity was measured using the Michigan Neuropathy Screening Instrument (MNSI), which is a brief 15-item questionnaire and

screening evaluation (Feldman et al., 1994). Variables of interest in this study were balance, balance confidence, occupational performance, and satisfaction with performance.

Balance

We used the Berg Balance Scale (BBS), considered the gold standard balance assessment in rehabilitation, to assess balance. The BBS is a 14-item physical performance measure of static and dynamic balance while performing functional activities (Berg, 1989). It has high inter-rater reliability, high internal consistency, and high intra-rater reliability (Berg, 1989)A balance impairment and fall risk is indicated if a person scores less than 45 (Berg et al., 1991). Additionally, minimal detectable changes (MDC), or the extent a score needs to change to be certain the change is greater than the measurement error, were determined for an elderly population by Donoghue et al. (2009) for the BBS. The MDC for the BBS is 6.3 for initial scores of 25-34; 4.9 for initial scores of 35-44; and 3.3 for initial scores of 45-56 (Donoghue et al., 2009).

Due to high BBS scores at baseline, we completed a post-hoc analysis of data from the Fullerton Advanced Balance Scale (FAB). The FAB is a 10-item performance measure of both static and dynamic balance under varying sensory conditions that challenge sensory integration. Higher scores indicate better balance. Patients are considered at risk for falls if they score a 25 (out of 40) or less. This scale has good convergent validity and high test-retest, intra-rater, and inter-rater reliability (Rose, Lucchese, &Wiersma, 2006). The BBS and FAB share multiple items, but the FAB is more challenging as it includes items such as stepping up and over a 6-inch bench, standing on foam with eyes closed, and reactive postural control.

Balance Confidence

Balance confidence was measured using the 16-item Activities-specific Balance Confidence Scale (ABC). The ABC is a self-reported assessment of the participant's level of

confidence in the static and dynamic balance while engaged in functional activities. Participants indicate their level of confidence in doing various activities without losing their balance or becoming unsteady by choosing a percentage point on a scale from 0% (no confidence) to 100% (completely confident). Higher scores indicate greater balance confidence in daily life activities and decreased fall risk. A score at or below 36.9 indicates an individual is at risk for falls. Psychometric testing of this scale indicated excellent internal consistency, test-retest reliability, and validity for older adults (Mancini et al., 2010; Myers et al., 1996; Powell et al., 1995).

Occupational Performance and Participation

We used the Canadian Occupational Performance Measure (COPM) to measure client's perception of activity performance and satisfaction with performance in the areas of self-care, productivity, and leisure (Carswell et al., 2004; Law et al., 1990). The COPM allows participants to identify occupational performance issues as defined by them, making it client-centered. Higher scores indicate increased perception of occupational performance and satisfaction with performance. A change of 2 points indicates clinical significance. The COPM has high test-retest reliability and high predictive and concurrent validity (Sewell et al., 2001). As would be done in a traditional occupational therapy intervention, we reviewed participant's self-reported items at 4- and 8-weeks.

3.4 Intervention

The intervention consisted of 60 minutes of yoga, 2x/week, for 8-weeks. Due to one cancellation from snow, there were 15 total yoga sessions. The yoga took place at the CSU Integrative Rehabilitation Lab and was taught by a registered yoga teacher (RYT). The RYT consulted with an experienced registered yoga therapist prior to the intervention to develop a therapeutic yoga protocol that appropriately addressed DPN symptoms.

The yoga intervention was implemented in two groups, which included no more than 10 people, to account for room space, yoga props, and yoga teacher attention throughout yoga sessions. The yoga was designed to elicit positive emotions, relaxation and to improve strength and flexibility at the torso, hips, neck, upper extremities and most importantly, lower extremities. It included dynamic movements outside the base of support (shooting star pose); various head positions; bending (seated cat/cow); twisting; balancing (tree pose); stepping; lunging (warrior 1); and reaching (seated and standing side bend). The yoga intervention was delivered in a standardized progression over 8 weeks in siting, standing and supine, allowing for the yoga to become more challenging and build upon prior skills. This progression allowed the participants to experience initial success, increasing self-efficacy for future classes. The intervention purposefully addressed the participant's mind, body, and spirit through yogic breathing exercises ("pranayama," in Sanskrit), positive affirmations, physical postures, and a guided relaxation at the conclusion of class (savasana). See Table 1 for the final yoga protocol.

3.5 Data Analysis

Datawere entered by a trained research assistant. All data were analyzed using SPSS Version 22.0 (SPSS, Inc., Chicago). First, we used descriptive statistics to describe the sample. Demographics and DPN characteristics were described with means, standard deviations, frequencies, and proportions as appropriate. Next, we used the Shapiro-Wilk test to assess normality of data. To assess before and after changes in balance, balance confidence, and occupational performance and satisfaction with performance, we used a paired- samples *t* test (or the non-parametric equivalent, Wilcoxon test, for non-normal data). Statistical significance was set at .05. To counteract the issue of multiple *t* test comparisons, we completed a Bonferroni correction (.05 divided by the number of variables; α=.05/4= .0125). We also calculated the

percent change for each variable using the following equation: Time 1-Time 2/Time 1*100. Lastly, the effect size (d_{Cohen}), or the quantitative representation of the magnitude of a phenomenon (Kelley et al., 2012) was determined for each variable by subtracting the means and dividing the difference by the mean (pooled) standard deviation (Mean 1 – Mean 2/ Mean SD). Thresholds for determining effect size are: .20 for small; .50 for medium: .80 for large; and 1.30 for very large (Cohen, 1988; Rosenthal, 1996).

After reviewing our data and finding high baseline BBS scores, we ran a post-hoc analysis of before and after changes for the FAB using a paired-t test.

Table 1: Yoga Protocol

Position	Description	Asana (yoga pose)
Seated	Slower, deeper, rhythmic breathing	2:1, Ujjayi, and DirgaSwasam (3-part) Pranayama, Simhasana (Lion's breath)
Weeks 1-8	Alternate Nostril Breathing- Brain Regulator	NadiShodhana
	Bilateral eye movements & hold eyes steady	DrishthiBheda
	Various head & neck positions & movements	
	Scapular ROM* & arm movements- Receptive gesture	UrdhvaHastasana
	Finger movements with counting	Mudras
	Seated spinal extension, flexion, lateral flexion, and rotation	Marjaryasana (Cat), Bhujangasana (Cobra), Alanasana (crescent moon)
	Hip rotation and stretching with ankle, foot, and toes ROM	EkaPadaRajakapotasana (Pigeon)
	Seated forward fold	Uttanasana
	Hand to opposite knee	ArdhaMatsyendrasana (Spinal Twist)
Standing	Standing with or without support	Tadasana (Mountain)
	Roll shoulders back and down	Shoulder Rolls- shoulders away from

	Knees bent, up & down on toes	ears
		Utkatasana (Chair)
	Dynamic balancing on one leg- one arm outstretched	Modified UtthitaTadasana (Shooting Star)
Weeks	Hip extension while standing	Salabhasana (Locust)
2-8	Prolonged lunges while standing	Virabhadrasana I (Warrior 1)
	Balance on 1 foot, with opposite sole placed on calf	Vriksasana (Tree)
	Toe/ball of foot, small knee bends w feet flat on floor	Variation of Utkatasana (Awkward)
Floor or	Posterior leg stretches	Modified Padangusthasana (Big toe)
mat	Supine extensions: bridge lifts	SetuBandhaSarvangasana (Bridge)
table	Knees into chest: separately then both at once- Energy release	Apanasana
Weeks	Hip rotation and stretching with ankle,	Supine EkaPadaUtkatasana (Figure
3-8	foot, and toes	four)
	Supine relaxation	Savasana (mindfulness meditation)

*ROM=range of motion

CHAPTER 4: MANUSCRIPT

4.1Introduction

In the United States, Diabetes Mellitus (DM) effects nearly 29.1 million people, accounting for about 9.3% of the national population (CDC, 2014). DM has a variety of causes and is a complex metabolic disorder that causes high blood glucose or hyperglycemia (NIDDK, 2011). It is estimated that 50% of people with DM have some degree of diabetic peripheral neuropathy (DPN), which is the manifestation of symptoms and/or signs of peripheral nerve dysfunction in the hands, arms, feet and/or legs (Boulton, 2005; Gordois et al., 2003).

DPN is a chronic condition that causes symptoms of: hypersensitivity to pain or touch; chronic pain; a tingling, burning or prickling sensation; and numbness(Argoff et al., 2006). These symptoms negatively impact one's life as they are associated: with depression; sleep disturbances; progressive muscle weakness; chronic pain; loss of occupational engagement; balance problems; and decreased quality of life (QoL) (Argoff et al., 2006; Textor et al., 2012). The growing prevalence of DPN has significant implications for occupational therapy (OT) in multiple settings as occupational therapists (OTR)'s play a valuable role in promoting health and preventing chronic disease and disability through participation in meaningful occupations(Gupta et al., 2015).

Researchers have identified balance as a major problem faced by those who experience DPN and linked it to somatosensory impairment (Richardson et al., 1996). Therefore, people with DPN are predisposed to falls which can lead to injury, decreased balance confidence, fear-related avoidance of activities, and decreased QoL(Delbaere et al., 2004; Richardson et al., 1996). It is important that OTs choose interventions that address balance and balance confidence

when working with people with DPN, as improvements are likely to lead to increased participation in daily occupations.

Meaningful participation in occupationshas been shown to positively influence health and well-being(Yerxa et al., 1990). However, people with DPN report that they no longer engage in their preferred meaningful occupations due to both physical and psychological factors (Fisher et al., 2007). While occupational therapists (OT) cannot change past life experiences that come to frame one's perception of their present situation, OTs can provide opportunities for people with DPN to experience positive emotions through competence or self-efficacy, which can alter values and beliefs. Positive emotions can lead to improved health and well-being and instill motivation for future participation in occupation (Eakman, 2015; Fisher et al., 2007).

DPN is a growing chronic condition affecting our current society and it is imperative to find evidence-based interventions that support diseasemanagement, self-efficacy, overall health and well-being, and QoL(Argoff et al., 2006; Richardson et al., 1996). Due to the fact that psychological and physical factors negatively impact the lived experience of people with DPN, a mind/body intervention may best serve this population. There is limited research regarding mind/body interventions for people with DPN. Li and Manor (2010) found group Tai Chi, a mind/body intervention, improved sensation and strength for 25 people with peripheral neuropathy; however, no significant changes in balance were found. Barnes and her team reported on the estimates of Complementary and Alternative Medicine use among US adults from a 2007 Health Survey(Barnes et al., 2008). Yoga was used at a rate almost six times that of Tai Chi. Due to many more adults in the United States (US) using yoga, yoga may be a more familiar and accessible mind/body intervention.Additionally, the Li and Manor study did not investigate the impact of Tai Chi on perceived occupational performance and satisfaction.

Yoga, a Sanskrit word meaning union of mind, body, and spirit,is another a mind/body intervention. In the West, yoga has evolved into a practice, involving positive affirmations, asanas (physical postures), pranayama (breathing), and relaxation. While yoga has never been studied within the DPN population, it has been shown to provide favorable results for people with DM and other chronic conditions including stroke, chronic heart failure, and COPD (A. A. Schmid et al., 2012; Woodyard, 2011). Malhorta et al. (2002) studied the efficacy of 40 days of 30-minute yoga sessions on nerve conduction velocity and basal blood glucose for people with Type 2 DM. The intervention group showed improvements in nerve function and glycemic control, whereas the control group's nerve function deteriorated. Further, yoga might be an effective tool for people with DPN as past research has revealed that yoga improves co-morbidities associated with DPN including: muscular strength; balance; balance confidence; sleep patterns; QoL; depression; and pain (Woodyard, 2011). Additionally, yoga is accessible due to the growing number and types of available classes in emerging studios, community centers, and hospitals(Barnes et al., 2008).

The Occupational Therapy Practice Framework outlines potential outcomes for practice including, but not limited to: participation; health and wellness; prevention; QoL; and adaptation (AOTA, 2014). All of these outcomes are affected by not only the physical body, but also by the psychological and spiritual aspects of the person (AOTA, 2014). Yogic philosophy, similar to occupational therapy, is concerned with physical, mental, and spiritual aspects of the person (Mailoo, 2006). AOTA has recommended that occupational therapists utilize yoga as a purposeful activity or preparatory method in practice to increase health and wellness (Giese, 2004).

There is a lack of evidence regarding the use of yoga for people with DPN. Our purpose was therefore to examine the preliminary efficacy of a group yoga intervention on balance, balance confidence, and occupational performance and satisfaction in adults with DPN.

4.2Methods

Research Design

This study was an uncontrolled pretest-posttest pilot study to explore yoga as a potential intervention for balance, balance confidence, occupational performance, and satisfaction with performance among adults with DPN. Data were collected before and after an 8-week group yoga intervention.

Recruitment and Participants

We recruited a convenience sample over 3 months. Participants were recruited through flyers, local hospitals, community centers, and DM support groups and resource fairs. Institutional Review Board approval and participant consent were obtained. Inclusion criteria included: self-report of DPN;verbal in English; scored a >4 out of 6 on the short 6 item Mini-Mental State Examination; and agreement to commit to assessments and 16 sessions of yoga. Potential participants were excluded if: they had consistently engaged in yoga for over a year; reported a terminal illness with life expectancy of < 6 months; and/or if they were unable to secure transportation to the sessions.

Outcome Measures

Data were collected by a trained research assistant and included basic demographics and DPN characteristics; including: age; race; gender; time since DPN onset; type of diabetes (pre-diabetes, type I, or type II); and location of symptoms. DPN severity was measured using the Michigan Neuropathy Screening Instrument (MNSI), which is a brief 15-item questionnaire and

screening evaluation (Feldman et al., 1994). Variables of interest in this study were balance, balance confidence, occupational performance, and satisfaction with performance.

Balance

We used the Berg Balance Scale (BBS), considered the gold standard balance assessment in rehabilitation, to assess balance. The BBS is a 14-item physical performance measure of static and dynamic balance while performing functional activities. It has high inter-rater reliability, high internal consistency, and high intra-rater reliability (Berg et al., 1991). A balance impairment and fall risk is indicated if a person scores less than 45 (Berg et al., 1991). Additionally, minimal detectable changes (MDC), or the extent a score needs to change to be certain the change is greater than the measurement error, were 6.3 for initial scores of 25-34; 4.9 for initial scores of 35-44; and 3.3 for initial scores of 45-56 (Donoghue et al., 2009).

Due to high BBS scores at baseline, we completed a post-hoc analysis of data from the Fullerton Advanced Balance Scale (FAB). The FAB is a 10-item performance measure of both static and dynamic balance under varying sensory conditions that challenge sensory integration. Higher scores indicate better balance. Patients are considered at risk for falls if they score a 25 (out of 40) or less. This scale has good convergent validity and high test-retest, intra-rater, and inter-rater reliability (Rose, Lucchese, &Wiersma, 2006). The BBS and FAB share multiple items, but the FAB is more challenging as it includes items such as stepping up and over a 6-inch bench, standing on foam with eyes closed, and reactive postural control.

Balance Confidence

Balance confidence was measured using the 16-item Activities-specific Balance Confidence Scale (ABC). The ABC is a valid and reliable self-reported assessment of the participant's level of confidence in static and dynamic balance while engaged in functional activities(Myers et al., 1996; Powell et al., 1995). Participants indicate their level of confidence

in doing various activities without losing their balance or becoming unsteady on a scale from 0% (no confidence) to 100% (completely confident). Higher scores indicate greater balance confidence in daily life activities and decreased fall risk. A score at or below 36.9 indicates an individual is at risk for falls. Psychometric testing of this scale indicated excellent internal consistency, test-retest reliability, and validity for older adults.

Occupational Performance and Participation

We used the Canadian Occupational Performance Measure (COPM) to measure clients' perception of occupational performance and satisfaction with performance in the areas of self-care, productivity, and leisure (Carswell et al., 2004; Law et al., 1990). The COPM is standardized and allows participants to identify occupational performance issues as defined by them, making it client-centered. Higher scores indicate increased perception of occupational performance and satisfaction with performance. A change of 2 points indicates clinical significance. The COPM has high test-retest reliability and high predictive and concurrent validity (Sewell et al., 2001). As would be done in a traditional occupational therapy intervention, we reviewed participant's self-reported items at 4weeks.

Intervention

The intervention consisted of 60 minutes of yoga, 2x/week, for 8-weeks. Due to one weather related cancellation, there were 15 total yoga sessions. The yoga took place at the CSU Integrative Rehabilitation Lab and was taught by a registered yoga teacher (RYT). The RYT consulted with an experienced registered yoga therapist prior to the intervention to develop a therapeutic yoga protocol that appropriately addressed DPN symptoms.

The yoga intervention was implemented in two groups, which included no more than 10 people. The yoga was designed to elicit positive emotions, relaxation and to improve strength and flexibility at the torso, hips, neck, upper extremities, and lower extremities. It included

dynamic movements outside the base of support (shooting star pose); various head positions; bending (seated cat/cow); twisting; balancing (tree pose); stepping; lunging (warrior 1); and seated and standing side bends (Table 1). The yoga was delivered in a standardized progression over 8 weeks in siting, standing and supine, allowing for the yoga to become more challenging and build upon prior skills. This progression allowed participants to experience initial success, increasing self-efficacy for future classes. The intervention purposefully addressed the participant's mind, body, and spirit through yogic breathing exercises (pranayama), positive affirmations, physical postures, and a guided relaxation at the conclusion of class (savasana).

Data Analysis

Data were entered by a trained research assistant and were analyzed using SPSS Version 22.0 (SPSS, Inc., Chicago). We used descriptive statistics to describe the sample, including means, standard deviations, frequencies, and proportions as appropriate for demographics and DPN. We then assessed normality of data with the Shapiro-Wilk. To assess before and after changes in balance, balance confidence, and occupational performance and satisfaction, we used a paired- samples *t* test (or the non-parametric equivalent, Wilcoxon test, for non-normal data). Alpha was set at .05, but we used a Bonferroni correction to control for multiple comparisons(.05 divided by the number of variables; α= .05/4 =.0125). We also calculated the percent change for each variable using the following equation: Time 1-Time 2/Time 1*100. Lastly, the effect size (d_{Cohen}), or the quantitative representation of the magnitude of a phenomenon (Kelley et al., 2012) was determined for each variable by subtracting the means and dividing the difference by the mean (pooled) standard deviation (Mean 1 – Mean 2/ Mean SD). Thresholds for determining effect size are: .20 for small; .50 for medium: .80 for large; and 1.30 for very large (Cohen, 1988; Rosenthal, 1996).

After reviewing our data and finding high baseline BBS scores, we ran a post-hoc analysis of before and after changes for the FAB using a paired-t test.

4.3Results

Twenty-two adults were recruited over a 3-month period and all individuals were eligible for the study. Of the 22 eligible individuals, 15 (68%) consented and participated in the study. Seven participants did not enroll in the study due to: newly planned surgery; illness; changes in work; transportation; and lack of child-care. As planned, participants were split into 2 yoga groups, each with no more than 10 individuals. Attendance rates ranged from 9-15 sessions and the average number of sessions attended was 12. Classes were missed due to weather (snow), illness, and conflicting life events such as doctor appointments. All participants completed the study and no adverse events were reported.

The mean age was 66 years (±11.77). Overall, participants were white (80%), female (53%), had some college education (73%), and had type II diabetes (87%)(Table 2). All (100%) participants reported neuropathy symptoms in the feet.

Table 3 includes baseline and 8-week scores, *p*-values, percent change, and effect sizes for all variables. After 8 weeks of yoga, BBS scores improved significantly ($p = .009$) and the effect size was medium (d_{Cohen}=0.65). Due to possible BBS ceiling effects, we included a post-hoc analysis of baseline and 8-week scores for the FAB; FAB scores also significantly improved after 8-weeks of yoga (28.20 ± 8.78 to 33.00 ± 8.08; $p = .020$). Additionally, balance confidence, as measured by the ABC scale, significantly improved after yoga. Scores improved from 68.96 ± 18.41 at baseline to 76.10 ± 17.38 at 8-weeks ($p = .004$).

Occupational performance and satisfaction with performance were measured with the COPM. The COPM yields an occupational performance score and a satisfaction with

performance score. Participants identified a range of 1-5 issues. Examples of identified issues included balance (occupational performance) and shopping with friends (participation). Both performance (3.23±1.46vs 5.57± 2.55, p<.001) and satisfaction scores (2.70±2.24 vs5.45±2.88, p<.001) significantly improved after yoga. Lastly, the effect sizes for performance and satisfaction were large (d_{Cohen} = 1.13, 1.07, respectively). BBS, ABC, and COPM scores all remained significant after the after the Bonferroni correction (p = .0125).

4.4Discussion

Despite a relatively small sample size, we found statistically significant improvements in the scores for all variables of interest. The data from this study showed that yoga improved balance, balance confidence, and occupational performance and participation among adults with DPN. The study further showed that changes can occur in only 8-weeks and that yoga provides an opportunity for people with DPN to engage in and benefit from a group mind-body intervention.

The modified progression of poses is ideal for this population, as the initial success provided an opportunity to build competence and self-efficacy. We predict that positive emotions related to achieving competence increased motivation to continue the study. Modification of poses for participants likely helped individuals move through the poses more successfully. Each group contained ≤10 participants, allowing the registered yoga teacher to provide individualized modifications and adjustments. The yoga protocol can potentially be implemented as a complement to traditional therapy in a group or individual formant and can be easily modified for various populations.

Due to initial success and positive emotions associated with the yoga class, we predict that participants were motivated to attend each session and continue participation until the end of

the study. In addition to having 100% of participants complete the study, 100% of the participants reported they may continue yoga. This suggests that while yoga started as a novel activity for all participants, their positive experience with it led them to report that they may add yoga to their repertoire of meaningful occupations. At the conclusion of the study, two participants reported plans to continue yoga at the senior center.

The participants in the study significantly improved their balance scores on both the BBS and FAB after 8 weeks of yoga. This may be due to improved strength and flexibility in the feet, ankles, and hips as well as improved body awareness. Data analyses revealed that 53% of the participants in our study demonstrated a MDC on the BBS. It should be noted that 33% of participants in our study had baseline scores that were too high to allow for a MDC of 3.3. Additionally, three participants crossed the fall risk cutoff (45) and showed MDCs: (1) 45 to 53 (change of 8); (2) 43 to 50 (change of 7); and 45 to 56 (change of 11). This suggests that yoga may reduce fall risk and balance impairment for adults with DPN. Regarding the FAB, zero participants scored 100% at baseline and 1 participant had a perfect score (40) at 8-weeks, suggesting that the FAB may be a better balance measure for this population.

Balance confidence also significantly improved after 8 weeks of yoga. Although the mean score at baseline (68.96 ± 18.41) was well above the fall risk cut-off of 36.9, significant improvements were still made, meaning participants became even more confident in their ability to not fall or lose balance. This change is relevant for OTRs as improvements in balance confidence are directly related to increased engagement in daily life activities and activity and participation (Bandura, 1991; Schmid et al., 2012).

While this is the first study to investigate yoga as a potential intervention for DPN, other studies have looked at various exercise interventions to address balance limitations within this

population. A systematic review of balance interventions for people with DPN found that lower extremity strengthening exercise was the sole intervention found to successfully address balance dysfunction in patients with DPN (Ites et al., 2011). This study provides support for utilizing yoga as an intervention. The changes we found in balance are similar to changes seen in a study that used a focused exercise regimen for people with DPN (Richardson et al., 2001). However, Richardson et al.'s study did not find a significant change in balance confidence. On the contrary, our study may have seen a change in balance confidence due to the holistic nature of yoga, as it addresses the mind, body, and spirit. It is possible that improvements in the mind-body connection led to improved balance confidence. Additionally, Li and Manor (2010) looked at the effects of Tai Chi on balance for people with DPN and did find significant changes in balance. Therefore, yoga may be a more successful mind/body intervention for the DPN population.

Finally, we found significant changes in performance and participation after 8-weeks of yoga. These changes were clinically significant because both mean scores changed by more than 2 points. This suggests that yoga, while not directly addressing identified issues with occupational performance, may still influence perceived occupational performance and participation. Therefore, OTRsmay consider using yoga as preparatory method or purposeful activity to support the primary outcomes of occupational performance and participation leading to better overall health and QoL. As Baun (2011) states, "The more that individuals do, the better off they are and the more likely they are to have stronger physiologic and psychological health" (p.171).

Limitations

Due to this being an exploratory study, a control group was not used and assessors were not blinded. Additionally, we included a convenience sample of 15 people from one

geographical area. While we cannot generalize these results to the DPN population, we were fortunate to recruit a nearly equal number men and woman, suggesting that yoga is an accessible activity for both genders. Despite these limitations, the significant results provide evidence that continued research should be done with a larger sample size and control group.

Implications for Occupational Therapy Practice

- Therapeutic yoga can lead to improved perceived occupational performance and participation and satisfaction in adults with DPN
- With additional training, OTs can use yoga interventions as a preparatory method or purposeful activity.
- OTs can use yoga to improve balance and balance confidence for individuals with DPN, which may lead to increased engagement in life activities.

Future Research

Future research should include a control group, a larger sample size, and randomization. Additionally, 82% of the participants reported with 'yes' or 'maybe' that yoga should be added to group DM self-management education. Future research should explore pairing a diabetes management class with a group yoga intervention.

4.5Conclusion

Adults with DPN can improve balance, balance confidence, and occupational performance and participation after 8-weeks of yoga. While this is an exploratory study, it provides preliminary evidence that OTRs can use yoga as an activity to improve performance and participation for adults with DPN, potentially leading to improved health and well-being.

Table 2: Yoga Protocol

Position	Description	Asana (yoga pose)
Seated	Slower, deeper, rhythmic breathing	2:1, Ujjayi, and DirgaSwasam (3-part) Pranayama, Simhasana (Lion's breath)
Weeks 1-8	Alternate Nostril Breathing- Brain Regulator	NadiShodhana
	Bilateral eye movements & hold eyes steady	DrishthiBheda
	Various head & neck positions & movements	
	Scapular ROM* & arm movements- Receptive gesture	UrdhvaHastasana
	Finger movements with counting	Mudras
	Seated spinal extension, flexion, lateral flexion, and rotation	Marjaryasana (Cat), Bhujangasana (Cobra), Alanasana (crescent moon)
	Hip rotation and stretching with ankle, foot, and toes ROM	EkaPadaRajakapotasana (Pigeon)
	Seated forward fold	Uttanasana
	Hand to opposite knee	ArdhaMatsyendrasana (Spinal Twist)
Standing	Standing with or without support	Tadasana (Mountain)
	Roll shoulders back and down	Shoulder Rolls- shoulders away from

	Knees bent, up & down on toes	ears
		Utkatasana (Chair)
	Dynamic balancing on one leg- one arm outstretched	Modified UtthitaTadasana (Shooting Star)
Weeks	Hip extension while standing	Salabhasana (Locust)
2-8	Prolonged lunges while standing	Virabhadrasana I (Warrior 1)
	Balance on 1 foot, with opposite sole placed on calf	Vriksasana (Tree)
	Toe/ball of foot, small knee bends w feet flat on floor	Variation of Utkatasana (Awkward)
Floor or	Posterior leg stretches	Modified Padangusthasana (Big toe)
mat	Supine extensions: bridge lifts	SetuBandhaSarvangasana (Bridge)
table	Knees into chest: separately then both at once- Energy release	Apanasana
Weeks	Hip rotation and stretching with ankle,	Supine EkaPadaUtkatasana (Figure
3-8	foot, and toes	four)
	Supine relaxation	Savasana (mindfulness meditation)

*ROM=range of motion

Table 3: Baseline demographics and DPN characteristics

Variable	All, N=15
Age (52-92 years)	66.43±11.77
Race, white	12 (80%)
Gender, female	8 (53%)
Years since DPN symptoms onset, > 5 years	5 (33%)
Years since Diabetes onset, > 5 years	9 (60%)
Education, some college education	11 (73%)
Type of Diabetes	
Type 2	13 (87%)
Pre-diabetes	2 (13%)
Severity	
MNSI patient questionnaire (13 point max)	6.13 ± 2.56
MNSI physical foot examination (10 point max)	7.83 ± 1.90
Where are DPN symptoms?	
Both hands and feet	9 (60%)
Feet only	6 (40%)

DPN: Diabetic Peripheral Neuropathy

MNSI: Michigan Neuropathy Screening Instrument

Table 4: Change in score between baseline and 8 weeks, n = 15

Variables	Yoga, n=15				
	Baseline	8 weeks	P-value*	% change T1-T2/T1 *100	Effect Size d_{Cohen}
Balance- BBS	49.33 ± 6.43	53.00 ± 4.68	.009†	7%	0.65- moderate
Balance Confidence (ABC Scale)	68.96 ± 18.41	76.10 ± 17.38	.004†	10%	0.4- small
Occupational Performance (COPM)	3.23 ± 1.46	5.57 ± 2.55	<.001†	72%	1.13- large
Satisfaction with Performance (COPM)	2.70 ± 2.24	5.45 ± 2.88	<.001†	102%	1.07- large

As appropriate, p-values were calculated using Paired *t*-tests for normal data and Wilcoxon signed-rank test for non-normal data.

†Significant after Bonferroni correction ($\alpha = .05/4 = .0125$)

CHAPTER 5: CONCLUSION

Adults with DPN can improve balance, balance confidence, and occupational performance and participation after 8-weeks of yoga. While this is an exploratory study, it provides preliminary evidence that OTRs can use yoga as an activity to improve perceived performance and participation for adults with DPN, potentially leading to improved health and well-being. With additional training, OTs can use yoga interventions as a preparatory method or purposeful activity.Future research should explore pairing a diabetes management class with a group yoga intervention.

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