EXAMINING THE IMPACT AND FEASIBILITY OF A SELF-EFFICACY BASED WALKING INTERVENTION FOR PERSONS WITH CHRONIC NON-SPECIFIC NECK PAIN

by

Marisa B. Scibilia

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing Science

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Marisa B. Scibilia

Approved: ____
Emily J. Hauenstein, Ph.D.
Senior Associate Dean for Nursing and Healthcare Innovation

Approved: ____
Kathleen S. Matt, Ph.D.
Dean of the College of Health Sciences

Approved: ____
Ann L. Ardis, Ph.D.
Senior Vice Provost for Graduate and Professional Education

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Ingrid Pretzer-Aboff, Ph.D.
Professor in charge of dissertation

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Gregory Hicks, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Tinagene Pia Inguito, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Veronica Rempusheski, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Regina Sims Wright, Ph.D.
Member of dissertation committee

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ABSTRACT

Purpose

The purpose of this study was to test the impact and feasibility of a motivational self-efficacy based walking intervention for people with chronic neck pain. The primary goals were focused on exercise adherence, self-efficacy beliefs for exercise, pain, function, range of motion, and quality of life. The secondary goal focused on the oxygenation of trapezius muscles in people with chronic neck pain.

Background

The global prevalence of neck pain is estimated to be 4.9%. Neck pain can negatively impact quality of life and functional ability. This motivational intervention was designed based on Bandura's Theory of Self-Efficacy.

Methods

A single group, pretest, two post-test repeated measures design was used. Twenty-five participants mean age 54.08 (range 40-79 y.o.) were asked to walk at a brisk pace for 150 minutes per week. The intervention was delivered at baseline to week 4. Data was collected at baseline, 4-weeks and 8-weeks.

Results

Twenty-four out of twenty-five (96%) of the participants were at least 80% adherent to the exercise protocol. There was improvement in current pain (p = 0.003), worst pain in the past 24 hours (p <.001) and neck disability (p <.001). Quality of life was improved in 4 of the 8 subscales: physical functioning (p = .014), role limitations due to physical functioning (p = .023), energy/fatigue (p = .016) and pain (p <.001).

Range of motion was improved in 4 of the 6 neck measurements. Resting oxyhemoglobin levels did not change over time, however, oxyhemoglobin levels increased when exercising the trapezius muscles for one (p = .007) and two minutes (p = .031) after 8 weeks of the walking intervention.

Conclusions and Implications

This feasibility study supports a motivationally based walking intervention for persons with chronic neck pain to improve pain, disability, quality of life, range of motion and neck muscle oxygenation. The significant findings in this study supports the need for a randomized controlled trial to adequately test the impact of this motivational walking intervention. This low cost intervention can be used by advanced practice nurses to improve exercise adherence and positively impact people with chronic neck pain.

Chapter 1

INTRODUCTION TO THE STUDY

Introduction

This chapter describes a research study that examines the impact and feasibility of a self-efficacy based walking intervention for persons with chronic non-specific neck pain. The research study focuses on exercise adherence to walking and the impact of a walking intervention on chronic neck pain. This first chapter of the proposal will introduce the background, purpose, theoretical framework, significance, research hypotheses, definitions of terms, assumptions of study and limitations.

Background

Neck pain is a common condition that affects millions of people worldwide. The global burden of neck pain is estimated to be 4.9% and is ranked 4th highest in years lived with disability (Hoy et al., 2014). Neck pain has been found to be most common in white, non-Hispanic women over the age of 35 (Strine & Hootman, 2007). People with neck pain have worse physical and mental health-related quality of life compared to those without neck pain (Daffner et al., 2003; Fanuele, Birkmeyer, Abdu, Tostenson, & Weinstein, 2000; Nolet et al., 2015) and decreased functional ability (Chan Ci En, Clair, & Edmondston, 2009). Significant healthcare dollars are spent on treatment of cervical spine pain (Borghouts, Koes, & Vondeling, 1999; Serrano-Aguilar, Kovacs, Cabrera-Hernandez, Ramos-Goni & Garcia-Perez, 2011). In 2005, an estimated 85.9 billion healthcare dollars in the United States were spent on people with back and neck problems (Martin et al., 2008).

Neck pain can be caused by a variety of mechanisms including trauma, infections, tumors, congenital disorders or inflammation (Borghouts et al., 1999). However, chronic non-specific neck pain (focus of this study) is not correlated with a specific pathology. Rather, it is often associated with muscular or ligamentous pain related to posture, poor ergonomics, stress, and/or chronic muscle fatigue (Rao, 2002). Some evidence suggests the etiology of non-specific neck pain may be related to decreased oxygenation due to impaired microcirculation of muscles in the neck such as the trapezius muscles (Anderson et al., 2010; Larsson, Oberg, & Larsson, 1999). In a study investigating the oxygenation of the trapezius muscles in women, researchers found both participants with and without chronic neck pain experienced improved oxygenation of the trapezius muscles after cycling (Anderson et al., 2010). In an earlier cycling study, acute cervical pain reduction was described with authors surmising the pain reduction may be partially related to improved oxygenation (Larsson, Oberg, & Larsson, 1999) as well as other factors such as a rise in beta-endorphins exercise (Goldfarb, Hatfield, Armstrong, & Potts 1990). The relationship of chronic neck pain, microcirculation and oxygenation of the trapezius muscles after walking has not yet been studied.

In this study, we investigated the effects of over ground walking on perceived pain. Walking is an easily implemented intervention, has little associated cost, and can be done in various places at the pleasure of the walker. Additionally, there is evidence that walking is related to a decreased incidence of neck pain. A prospective study revealed that an increase in walking by 1,000 steps per day reduced the risk of neck pain by 14% (Sitthipornvorakul, Janwantanakul, & Lohsoonthorn, 2015). Additionally, all-around physical exercise (any exercise not specific to the neck or shoulder region, and may include walking) was found to be as effective as specific resistance training of the neck and shoulder region in reducing duration and intensity of neck and shoulder symptoms (Blangsted et al., 2008).

Exercise has been shown to be an effective form of treatment for chronic neck pain; however, exercise adherence has been low (Dunlop et al., 2011; Karlsson, Takala, Gerdle, & Larsson, 2014; Krein, Heisler, Piette, Butchart, & Kerr, 2007). Factors for low exercise adherence not specific to a diagnosis include pain, sickness, lack of time, economic factors and low motivation (Leijon, Faskunger, Bendtsen, Festin & Nilsen, 2011). In order to understand the facilitators and barriers to exercise in people with cervical neck pain, a qualitative research study was conducted (Scibilia & Pretzer-Aboff, unpublished). Analysis of the data resulted in the emergence of several themes including lack of personal motivation, competing priorities and fear of increased pain. For this reason used a motivationally based walking intervention for this study. Motivational techniques have been successful in improving adherence and compliance in exercise interventions for people with chronic pain resulting in decreased pain and improved physical mobility, psychological well-being, and self-efficacy for persons with chronic pain (Frih, Jellad, Boudoukhane, Rejeb, 2009; Resnick, 2002; Tse, Vong, & Tang, 2013).

Bandura's Theory of Self-Efficacy (1986) identified four variables to guide participants' judgement about self-efficacy and outcome expectations: enactive attainment, vicarious experience, verbal persuasion, and physiological state. The intervention proposed in this dissertation is based on the Theory of Self-Efficacy. It is designed to assist participants in overcoming barriers associated with exercise adherence and motivate them to participate in and continue to exercise. The theoretical underpinning of the self-efficacy based walking intervention used in this study are the concepts of Bandura's Social Cognitive Theory: person, behavior, and environment. Human functioning and decision-making are viewed in a dynamic relationship between personal, behavioral and environmental factors.

Purpose of the Study

The primary purpose of this research study was to examine the impact and feasibility of a motivational self-efficacy based walking intervention for people with chronic neck pain in the community setting. Primary goals of this study were focused on exercise adherence, increasing self-efficacy beliefs for exercise, and improving pain, function, range of motion, and quality of life. The secondary aim focused on changes in oxygenation to the trapezius muscle as a result of the walking intervention.

Theoretical Framework

Bandura (1997) developed a theory of self-efficacy, based on social cognitive theory, built on the assumption that people can exert influence over what they do. Through thought, knowledge and skills to perform a certain behavior and other tools of self-influence, a person will decide how to behave. An individual's behavior is under reciprocal influence of behavior, cognitive factors and environmental situations (Bandura, 1986). The triad of variables interact as determinants of each other (Figure

1). For example, a person has chronic neck pain and physical activity results in a slight increase in discomfort (person-biological). A friend told the individual that increasing activity will do damage to the neck (environmental-social). Fear of doing further harm (personal-affective) prevents the person from engaging in physical activity.

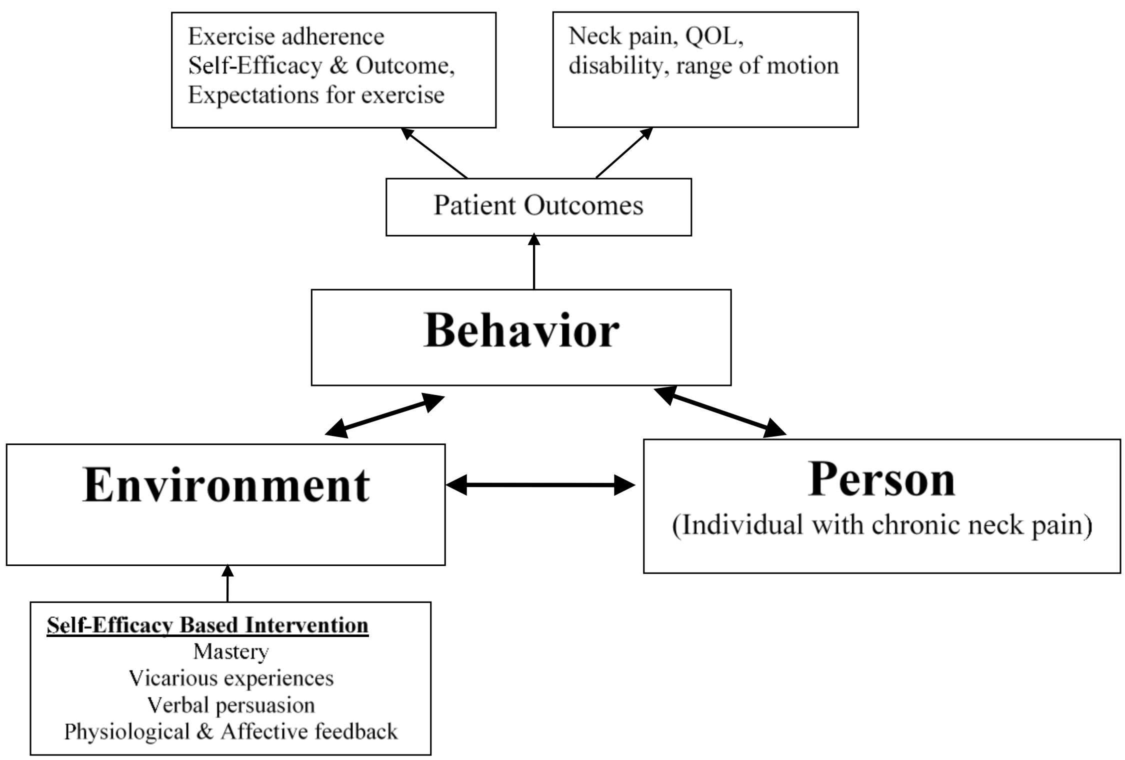

Figure 1. Relationship between Social Cognitive Theory, Intervention and Outcomes.

The Theory of Self-Efficacy focuses on self-efficacy expectations and outcome expectations. Self-efficacy refers to an individual's belief that she is capable of a behavior. Outcome expectations are an individual's beliefs about what will happen after a task is completed. Bandura describes four mechanisms that guide self-motivation to change behavior: (1) successful performance of the activity of interest, (2) verbal persuasion, (3) seeing like individuals perform a specific activity, and (4) physiological and affective states. The theory of self-efficacy suggests that the four mechanisms result in stronger self-efficacy and outcome expectations, which results in an increased likelihood that the individual will be motivated to initiate and persist with a given activity.

Self-efficacy beliefs provide the underpinning for human motivation. Individuals need to believe their actions can produce the outcomes they desire, otherwise they will have little likelihood to act or persevere if faced with difficulties. The motivational walking intervention used for this study was designed to increase an individual's self-efficacy and outcome expectations in walking as treatment for chronic neck pain.

Significance of the Study

The study makes a contribution to the knowledge of symptom management of chronic neck pain. Knowledge gained from this study could positively impact patients suffering with chronic neck pain. An intervention focused on exercise adherence will add to knowledge of human motivation to change behavior. Additionally, the impact of walking on neck pain was examined. A little to no cost intervention could potentially provide benefits for improving pain, range of motion and quality of life. The results of the impact and feasibility study assist in determining if a randomized controlled trial is warranted.

Research Hypothesis

The following are the research hypotheses for the study:

Hypothesis 1: People with chronic neck pain who participate in a self-efficacy based walking intervention will adhere to at least 80% of the recommended exercise.

Hypothesis 2: People with chronic neck pain who participate in the self-efficacy based walking intervention will demonstrate increased self-efficacy expectations (Self-efficacy for Exercise Scale) and outcome expectations for exercise (Outcome Expectations for Exercise Scale).

Hypothesis 3: People with chronic neck pain who participate in the self-efficacy based walking intervention will report a reduced level of neck pain (Numeric Pain Rating Scale) and improved function (Neck Disability Index), range of motion (goniometer) and quality of life (Bournemouth Questionnaire).

Hypothesis 4: People who participate in the self-efficacy based walking intervention will experience increased oxygenation to the trapezius muscles (determined using near-infrared spectroscopy).

Definitions of Terms

The conceptual and operational definitions of terms used in this study are as follows:

Chronic neck pain is defined as a person's perception of pain within a region bordered superiorly by the superior nuchal line, laterally by the lateral margins of the neck and inferiorly at the level of T1 for a minimum of 3 months (Bogduk, 2003).

Non-specific neck pain is defined as neck pain that no specific pathology can be identified as responsible for the pain (Binder, 2007).

Self-efficacy for expectations for exercise is defined as a person's belief in his/her confidence to participate in exercise. In this study the participant's self-efficacy for exercise was operationalized using the Self-efficacy for Exercise (SEE) scale (Resnick & Jenkins, 2000).

Outcome expectations for exercise is defined as the person's belief that certain consequences will be produced by participating in exercise. In this study the participant's outcome expectations for exercise was operationalized using the Outcome Expectations for Exercise Scale (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000).

Quality of Life is defined as a person's ability to maintain a standard of living that meets social, physical and psychological needs. In this study the 36-Item Short Form Health Survey was used to assess the areas of physical functioning, bodily pain, role limitations due to health problems, role limitations due to personal or emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions (Hays & Morales, 2001).

Neck muscle oxygenation is defined as measurement of oxy-hemoglobin, deoxyhemoglobin and total hemoglobin of the trapezius muscles. In this study the Artinis Portamon near infrared spectroscopy was used for measurement of oxygenation.

Assumptions of the Study

The following assumptions underlie the research questions of this study:

1. Study participants understand the questions asked and complete the questionnaires accurately.
2. Tracking of exercise adherence reflects reality accurately.
3. Measurements for neck muscle oxygenation will be accurately measured by Artinis Portamon device.
4. Pain, neck disability, self-efficacy and outcome expectations and range of motion can be measured by selected instruments.
5. A person can exert influence over his or her actions.
6. A person's thoughts about his or her abilities are influenced by direct experience, vicarious experience, judgments of others and previous knowledge.

Limitations

The anticipated limitations were as follows:

1. A convenience sample of individuals with chronic non-specific neck pain was obtained, therefore the findings are not generalizable beyond a similar group.
2. The use of volunteer participants may result in self-selection bias since volunteers may be more motivated to participate and more interested in learning.
3. Construct validity of the outcome measures may be affected because the same person who administered the intervention administered the outcome measures.

Summary

In summary, chronic neck pain is a common condition which is not well understood and for which there is not a single most effective treatment option. This study examined the effect of a motivational walking intervention on pain, function, quality of life, range of motion and oxygenation of neck muscles. Chapter 1 described the background, purpose of the study, theoretical framework, significance, research hypotheses, definitions of terms, assumptions of the study and finally anticipated limitations of the study.

Chapter 1

REVIEW OF THE LITERATURE

Introduction

Neck pain is a common occurrence which can cause mild to severe disability for those affected. Research supports several conservative treatment options that are effective in reducing pain including exercise. Despite empirical evidence supporting efficacy of exercise in reducing pain, participation and adherence to exercise is low. Barriers to exercise for persons with chronic neck pain include lack of motivation to exercise, competing daily priorities, and fear of increased pain.

The purpose of this study was to examine the feasibility and impact of a self-efficacy based walking intervention for persons with chronic neck pain. The primary outcomes investigated in this research were exercise adherence, self-efficacy and outcome expectations for exercise, intensity of neck pain, range of motion, functional disability, and quality of life. Secondary goals focused on oxygenation of the trapezius muscles of persons with chronic neck pain before and after the exercise intervention to determine if walking improves the trapezius muscle oxygenation.

This chapter will include a review of the literature presenting prevalence and etiology of neck pain, anatomy, pathophysiology, impact of neck pain, current treatment, exercise adherence, and barriers to exercise. Preliminary results of a qualitative study regarding facilitators and barriers to exercise will be discussed (Scibilia & Pretzer-Aboff, 2015, unpublished data). Bandura's theory of self-efficacy and social cognitive theory will be presented.

Prevalence and Etiology of Neck Pain

Neck pain is a complex and multifactorial phenomenon. It can be attributed to a variety of mechanisms including trauma, infections, tumors, congenital disorders and inflammation (Borghouts et al., 1999). Often no specific pathology can be related to the neck pain and in these cases it is labeled non-specific neck pain (Binder, 2007). Neck pain of this type is often related to muscular or ligamentous factors and can be associated with posture, poor ergonomics, stress, and/or chronic muscle fatigue (Rao, 2002). Degenerative changes of the cervical spine can also play a role in non-specific neck pain; however, this is poorly understood as individuals with degenerative changes are also frequently asymptomatic (Binder, 2007).

Incidence and prevalence estimates vary significantly in the literature. One source of information is the National Health Interview Survey. This survey used in-person interview techniques and has been administered annually since 1957 to a sample of Americans across all fifty states and the District of Columbia. The National Health Interview Survey was a collaborative effort between the Centers for Disease Control and Prevention, the National Center for Health Statistics, and the US Census Bureau. Researchers who studied the 2002 National Health Interview Survey used data obtained on 29,828 respondents to calculate prevalence estimates of neck pain (Strine & Hootman, 2007). They estimated that 13.7% of adults ≥ 18 years of age reported neck pain in the previous three months. The results also showed prevalence of neck pain to be more common in adults over the age of 35, women, and white, non-Hispanics. Those who were never married were significantly less likely to report neck pain than those who are married or were previously married. The limitations of the National Health Interview Survey were that it did not include information of pain location, intensity or duration of pain (Strine & Hootman, 2007).

Additional information with regard to prevalence could be obtained from a subset of the Global Burden of Disease 2010 Study, which included the estimation of the global burden of neck pain in 188 countries around the world (Hoy et al., 2014). In this study, researchers analyzed systematic reviews and national health surveys to estimate overall prevalence, and years lived with disability. The global prevalence of neck pain was estimated to be 4.9% (95% CI 4.6 to 5.3). It was higher in women (mean 5.8%) than in men (mean 4.0%) and peaked around 45 years of age. Disability-adjusted life years was 23.9 million in 1990 (95% CI 16.5 to 33.1) and increased to 33.6 million in 2010 (95% CI 23.5 to 46.5). There were 291 conditions studied in the Global Burden of Disease 2010 Study. Neck pain ranked 4th highest in terms of disability as measured by years lived with disability. Neck pain was ranked 21st in overall burden. This study shows prevalence and burden of neck pain are high throughout the world.

Basic Anatomy and Normal Kinematics of the Cervical Spine

The neck is a complex structure with many components which could be potential sources of pain. A basic understanding of the anatomy of the neck as well as normal movement will assist in understanding the possible origins of neck pain. The neck is comprised of several structures including bones, discs, ligaments, muscles, blood vessels, the spinal cord and spinal nerves. All structures work in tandem to provide a normal range of motion. A person's normal range of motion should be approximately 80 to 90 degrees of flexion, 70 degrees of extension, 20 to 45 degrees of lateral flexion and up to 90 degrees of rotation to each side (Swartz, Floyd, & Cendoma, 2005), without pain. The following is a review of the anatomy of the neck as well as normal kinematics of the neck thus providing an overview of the complexity of the neck and the many potential sources of neck pain.

Bony structures. The cervical spine is comprised of seven vertebrae. The vertebrae are divided into two groups: C1-C2 and C3-C7. The first cervical vertebra, or the atlas, provides a cradle for supporting the head. It forms a joint with the occipital condyles, known as the atlanto-occipital joint. The primary motion of the joint between the occiput and first cervical vertebra is flexion and extension, ranging between approximately 15 degrees and 20 degrees (Bogduk & Mercer, 2000). The axis is the second cervical vertebra. The atlanto-axial joint is formed by the atlas and axis. It is stabilized by 3 primary ligaments: the transverse, alar and apical. The ligaments allow the atlas to rotate on the odontoid process of the axis. The normal rotation of the atlanto-axial joint is approximately 50 degrees to each side (Bogduk & Mercer, 2000).

The lower cervical spine consists of five vertebrae, C3-C7. Intervertebral joints, or facets, are present on the lateral aspects of the vertebrae (Swartz, Floyd & Cendoma, 2005). The facet joints allow for rotation and flexion movements, but not lateral flexion (Swartz, Floyd & Cendoma, 2005). Lateral flexion is possible by coupled rotational movement between the vertebral bodies of C3-C7 (Swartz, Floyd &

Cendoma, 2005). Understanding the movement of the neck is important for several reasons: cervical joints can be a cause of neck pain (Bogduk & Marsland, 1988), movement of the neck can illicit pain in various structures, and range of motion of the cervical spine can be restricted by persons with neck pain.

Intervertebral discs. Between each cervical vertebral body of C2 through C7 lies an intervertebral disc. Twenty to twenty five percent of the height of the adult cervical column is comprised of disc (England, 1971). The discs permit a limited amount of motion between the adjacent vertebral bodies. It is suggested this part of the disc may have a water content of up to 80 percent (England, 1971). The cartilaginous pate is a thin layer on the top and bottom of the disc between the disc and the vertebral body (England, 1971).

Bland and Boushey (1990) studied 171 whole cervical spines from human cadavers between 1954 and 1984. They found that the nuclei pulposi of the cervical discs is present at birth and gradually diminishes through adolescence. By the age of 40, the nuclei pulposi have disappeared. The adult disc is dry and ligamentous-like and composed of fibrocartilage, hyaline cartilage and tendon-like material with little or no proteoglycans. Intervertebral discs are innervated by branches of the ventral rami (Bogduk, 1985), therefore, the intervertebral discs are thought to have the ability to produce pain. It is not understood whether the change in disc material resulting from the aging process contributes to cervical pain.

Ligaments. The anterior longitudinal ligament extends from the axis down the entire length of the spine along the anterior and anterolateral surfaces of the vertebral bodies (England, 1971). This ligament is attached firmly to the vertebral bodies but loosely to the disc area (Bland & Boushey, 1990). The anterior longitudinal ligament is thicker at the center of the ligament and thinner laterally and limits cervical extension (England, 1971).

The posterior longitudinal ligament extends from the axis down the entire length of the spine along the posterior aspect of the vertebral bodies within the spinal canal (England, 1971). It is firmly attached to the disc area but loosely to the vertebral bodies and is three to five times thicker in the cervical spine than the thoracic or lumbar spine (Bland & Boushey, 1990). The posterior longitudinal ligament limits cervical flexion (England, 1971).

The spinous processes on the posterior aspect of the spine are attached by supraspinal ligaments (England, 1971). The nuchal ligament is continuous with the supraspinal ligaments and extends from the occiput to the spinous process of C7. It forms a septum between the muscles in the midline. The trapezius and splenius capitis muscles arise from the nuchal ligament (England, 1971).

Ligaments of the cervical spine are innervated by branches of the ventral rami and therefore provide potential sources of pain (Bogduk, 1985). Ligaments are prone to damage when abnormal forceful movement of the head or cervical spine takes place.

Spinal cord and spinal nerves. The bony structures of the spinal column give protection to the spinal cord and spinal nerve roots. The spinal cord is located in the spinal canal surrounded by cerebrospinal fluid and encapsulated in the dura mater.

There is a large variation between space in the spinal canal and size of spinal cord (Bland & Boushey, 1990). There are cervical nerves that stem from the cervical spinal cord both anteriorly and posteriorly. The nerve roots exit the spinal canal through a ring on the lateral aspect of the vertebral body called the foramen (England, 1971). The nerves control the movement and sensation of the upper extremities in regions called dermatomes (Figure 2). As shown on the dermatome map, C3 and C4 nerve roots correlate with the neck region and could be an additional source of pain (Lee, McPhee, & Stringer, 2008).

The spinal cord and spinal nerve roots are important to recognize as a potential source of neck pain, however, impingement of the spinal cord or spinal nerve roots must be evaluated for surgical intervention.

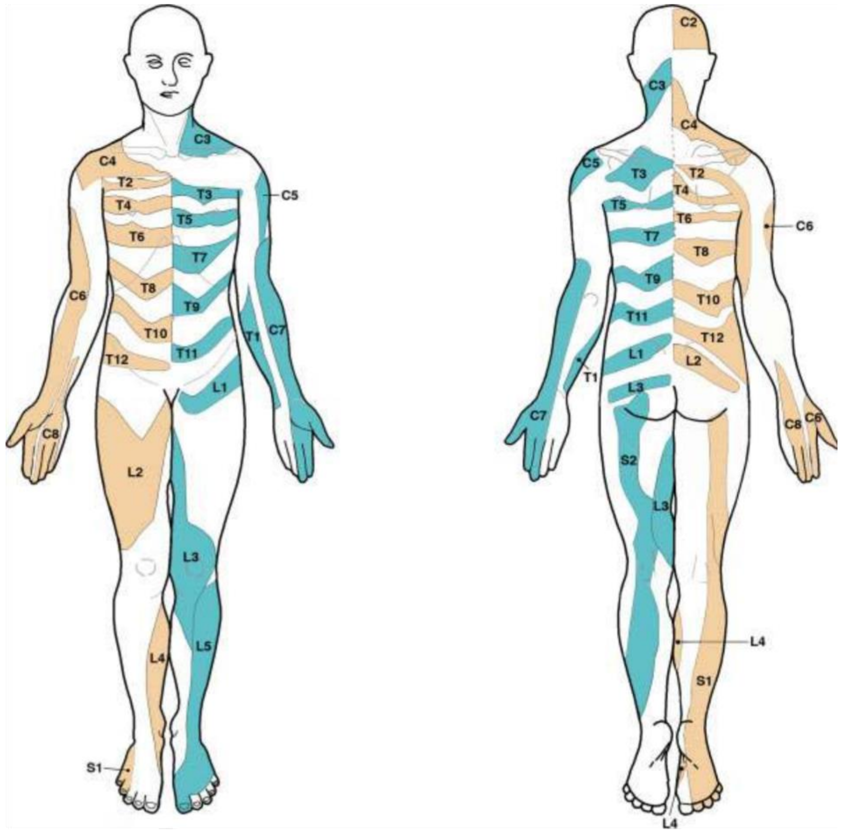

Figure 2. An illustration of spinal dermatomes. The blank regions are areas of variability and overlap. Adapted from “An evidence-based approach to human dermatomes,” by M. W. Lee, R. W. McPhee, & M. D. Stringer, 2008, *Clinical Anatomy*, 21, p. 371.

Blood supply. The spinal column receives its blood supply from branches of the vertebral artery which ultimately divide into three terminal branches: dorsal, intermediate and ventral (England, 1971). The dorsal branches supply the dura mater of the spinal cord, pedicles, transverse processes, lamina and spinous processes. The intermediate branches supply the dura mater of the nerve roots and help supply the spinal cord. The ventral branches supply the vertebral bodies, anterolateral aspect of the spinal dura mater epidural space. The vessels of adults do not reach the intervertebral discs. The vertebral vessels originate from the carotid arteries (England, 1971).

The carotid arteries and subclavian arteries contribute to the microcirculation of all of the neck muscles. Red blood cells travel through branches off the main arteries to the capillaries. Oxyhemoglobin is oxygen bound to the heme component of the protein hemoglobin in red blood cells. Oxygen releases from oxyhemoglobin and passes through capillary walls into the muscle cells. Deoxyhemoglobin is the form of hemoglobin without the bound oxygen (Pittman, 2013).

Neck muscles. The components of the spinal column work with the surrounding muscular system to support the weight of the 10-15 pound head and generate multidirectional movements. A complex system of greater than 20 pairs of superficial and deep muscles comprise the musculoskeletal anatomy of the neck to accomplish these tasks (Blouin, Seigmund, Carpenter, & Inglis, 2007). The two categories of cervical neck muscles, deep and superficial, are thought to have different roles. The deep muscles are smaller and attached to cervical vertebrae. Their primary role is believed to stabilize the spine (Cagnie et al., 2009). The superficial muscles are longer, have attachments to the skull and trunk, and are believed to have a primary role in three dimensional movement of the neck (Cagnie et al., 2009).

Cervical flexor muscles are located on the anterior aspect of the neck and consist of both superficial and deep muscles. Deep cervical muscles include the longus capitis and longus colli (Falla, Jull, & Hodges, 2004). The deep cervical flexors articulate with the cervical vertebral bodies and control the cervical curve. Superficial cervical flexors include the sternocleidomastoideus and anterior (AS), middle (MS) and posterior (PS) scalene muscles. The scalene muscles arise from the transverse processes of the cervical spine and attach to the first or second rib. A study of the scalene muscles on nine cadavers revealed scalene muscles were responsible for lateral flexion and ipsilateral rotation of the neck and elevation of the first and second ribs (Olinger & Homier, 2010).

Neck extensor muscles are located on the posterior aspect of the neck and also consist of both deep and superficial muscles (Figure 3). Deep muscles include the multifidus, rotatores and semispinalis cervicis which together form the transversopinalis muscle (Schomacher & Falla, 2013). These muscles produce extension, ipsilateral side-bending and contralateral rotation of the neck (Anderson, Hsu, & Vasavada, 2005). The semispinalis capitis arises from the facet joints of the 4^{th}, 5^{th} and 6^{th} cervical vertebrae and attaches to the occipital bone. Superficial neck extensors include the splenius capitis, levator scapulae and trapezius. They play a role in extension, ipsilateral rotation and ipsilateral side-bending of the neck (Schomacher & Falla, 2013).

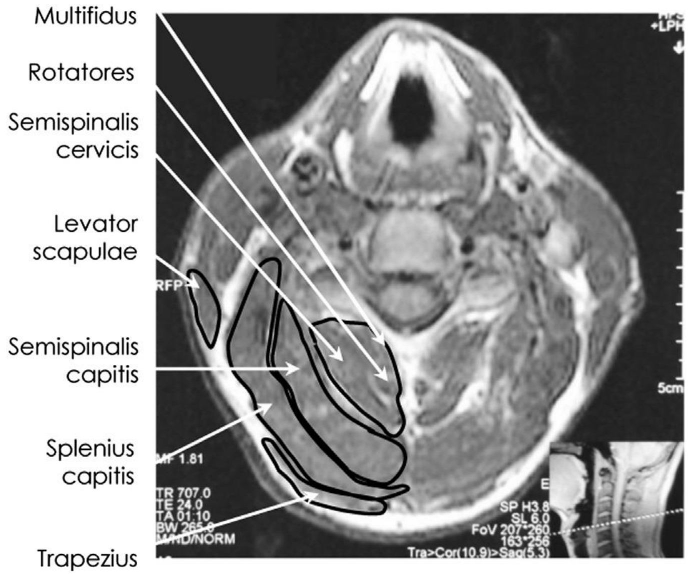

Figure 3. MRI scan of the neck of a healthy 45 year old male showing the cervical extensor muscles from an axial view. Adapted from “Function and structure of the deep cervical extensor muscles in patients with neck pain,” by J. Schomacher & D. Falla, 2013, *Manual Therapy*, 18, p. 361.

The trapezius muscles are large superficial muscles extending from the occipital bone to the lower thoracic vertebrae. The trapezius muscles are classified into three functional regions: the superior fibers, the middle fibers and the inferior fibers. The superior fibers of the trapezius muscle are located in the neck region. They originate from the occipital bone, nuchal ligament and spinous process of C7. The muscle fibers extend downward and laterally from the center of the neck to the posterior lateral third of the clavicle (Schomacher & Falla, 2013). This large superficial muscle is most accessible for measurement of microcirculation.

The anatomy of the neck presented illustrates the complexity of the neck and describes various sources of potential neck pain. The source of neck pain is controversial. Non-specific neck pain results from postural and mechanical causes and is not identifiable from one specific structure of the neck (Binder, 2007). There are many contributing factors which could illicit pain in an individual. The structural and functional components of the neck have been reviewed; next the pathophysiology of neck pain will be presented.

Pathophysiology of Neck Pain

A thorough review of the literature reveals that the pathophysiology of neck pain is not well understood. Neck pain is an individual's perception of pain within a region bordered superiorly by the superior nuchal line, laterally by the lateral margins of the neck and inferiorly at the level of T1 (Bogduk, 2003). The location of neck pain does not necessarily indicate the source of pain. Each of the various components of the cervical spine is innervated, which provide potential sources of neck pain. All of the muscles, joints, arteries, dura mater and intervertebral discs can be innervated and therefore may be the potential source(s) of neck pain (Bogduk, 2003). Various structures of the cervical spine have been studied to see if they could be a source of cervical pain. An understanding of the various potential sources and mechanisms of neck pain can help researchers and clinicians develop effective treatment interventions.

Facet joints and dorsal rami. In a study of asymptomatic volunteers, Dwyer, Aprill, & Bogduk (1990) stimulated cervical facet joints from C2-3 to C6-7 in five volunteers by distending the joint capsule with injections of contrast medium. The researchers found that stimulation of the joints resulted in similar patterns of pain in each of the volunteers (Figure 4). From the C2-3 level, pain was referred to the occipital region of the head. Stimulation of C3-4 and C4-C5 resulted in pain in the posterior aspect of the neck. Stimulation of C5-6 resulted in pain spread over the supraspinous fossa of the scapula. Stimulation of C6-7 caused pain further caudally over the scapula.

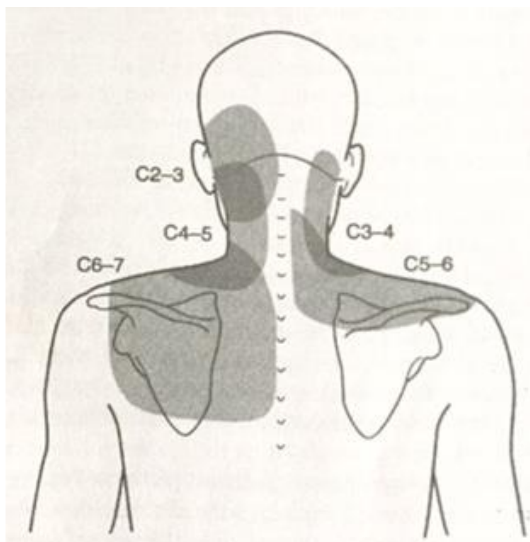

Figure 4. Distribution of pain following stimulation of facet joints. Adapted from “The anatomy and pathophysiology of neck pain,” by N. Bogduk, 2003, *Physical Medicine and Rehabilitation Clinics of North America, 14,* p. 460.

The cervical facet joints were further studied in 61 patients with occipital, neck or shoulder pain of suspected facet origin (Fukui et al., 1996). The pain was reproduced by injection of contrast medium into the joints (C0-1 to C7-T1) or by electrical stimulation of the dorsal rami (C3 to C7). The pain patterns were mapped when the patient’s usual pain was reproduced. The researchers found the same distribution of pain from the facet joints as did Dwyer, Aprill, & Bogduk (1990). Furthermore, pain patterns from the dorsal rami were identified. The dorsal rami of C3 produced pain in the occipital region and upper posterior cervical region. Pain in the middle posterior region was produced from C4. Pain in the lower posterior cervical region was produced from C4 and C5. Pain in the suprascapular region was referred from C4. The superior angle of the scapula and mid-scapular region had pain referred from C6 and C7 spinal nerves.

These two important studies provided knowledge of pain distribution relating to specific cervical facet joints, thus neck pain may be a result of immediate underlying structures, or referred pain from facet joints or another location such as intervertebral discs.

Intervertebral discs. In an early study, Cloward (1959) investigated neck pain of 114 patients using cervical discography. A cervical discogram is a procedure in which a needle is inserted into the intervertebral disc and a radio-opaque solution in injected. The radio-opaque characteristic of the solution allows for visibility of damage to the cervical disc on imaging studies. The patient is awake during the procedure to inform if pain is elicited and the location of the pain (Cloward, 1959). The purpose of his study was to analyze abnormalities of the intervertebral discs and characteristics of pain elicited from the injections from the discs and surrounding ligaments. The pain patterns identified by Cloward (1959) were similar to the distribution of pain elicited from the facet joints with the exception of occipital pain.

The structures identified as being responsible for the referred cervical pain included the annulus fibrosus of the disc and the anterior and posterior longitudinal ligaments.

Spinal cord and spinal nerve roots. There are a variety of degenerative changes that can contribute to compression of the spinal cord and spinal nerve roots that can be responsible for or contribute to neck pain. As shown in Figure 5, discs, osteophytes, joints and ligaments can be various sources of compression on the spinal cord or spinal nerve roots (Bernhardt, Hynes, Blume & White, 1993). Mechanical compression of spinal nerves can be a primary source of pain in the corresponding dermatomes at the level of deformity.

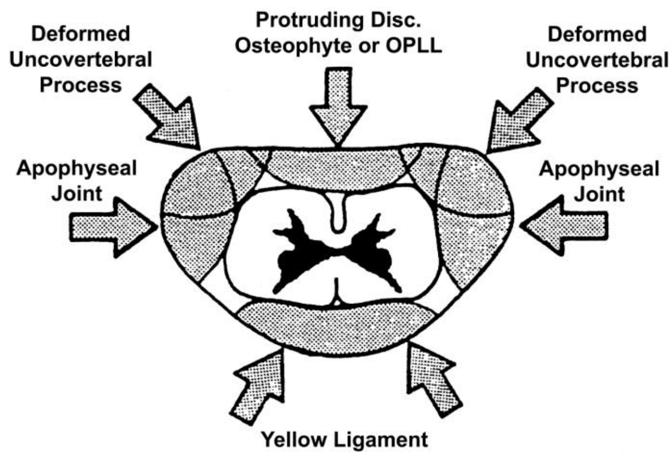

Figure 5. Degenerative changes that contribute to compression of the spinal cord and/or spinal nerve roots. OPLL = ossification of the posterior longitudinal ligament. Adapted from "Current concepts review: cervical spondylotic myelopathy," by M. Bernhardt, R. A. Hynes, H. W. Blume, & A. A. White, 1993, *Journal of Bone and Joint Surgery – American Volume*, 75, p. 120.

Neck muscles. Pain in the neck muscles is not well understood although neck pain is often attributed to chronic muscle fatigue (Rao, 2002). Neck muscles contain free nerve endings which are chemonociceptive and mechanonociceptive units. Chemonociceptive nerve endings may respond to changes in metabolites in the muscles (Rao, 2002). Mechanonociceptive nerve endings respond to stretch or pressure of the muscles (Rao, 2002). Sensitization of these nerve endings in the neck muscles may be a primary source of neck pain.

Metabolic changes. Researchers studied metabolic changes of neck musculature in an effort to further understand the painful neck physiology. Researchers found that when exercising the brain secrets beta-endorphin which is a chemical that lessens pain (Goldfarb, Hatfield, Armstrong, & Potts, 1990; Karlsson et al., 2015). Using microdialysis which is a method to measure intercellular concentrations of various substances using dialysis probe inserted into the tissue and a micropump, Karlsson et al. (2015) compared metabolic differences between 41 women with chronic neck and shoulder pain and 24 control heathy women without pain. They found higher concentrations of glutamate and betaendorphin and lower concentrations of cortisol in the women with chronic neck and shoulder pain as compared to healthy subjects. In another study, Gerdle et al. (2008) found significantly higher interleukin-6 and serotonin in the resting trapezius muscles of 22 women with chronic neck pain compared to 20 control healthy women. Sjøgaard et al. (2010) found 25% higher lactate, 40% higher pyruvate and 18% lower blood flow during exercise in 43 women with chronic neck pain as compared to the control group.

Microcirculation. Persons with chronic neck pain have been found to have impaired microcirculation of the trapezius muscles. Neck muscle oxygenation has been studied using near-infrared spectroscopy to measure oxyhemoglobin and total hemoglobin of the muscles. In a study of 14 women with chronic neck pain compared to 12 women without pain, Shiro, Arai, Matsubara, Isogai and Ushida (2012) found that women with neck pain had lower oxygenation and total hemoglobin of the trapezius muscles after 2 minutes of maximum effort isometric exercise of the trapezius muscles. Furthermore, Larsson, Öberg, & Larsson (1999) studied 76 subjects with chronic neck pain and found statistically significant ($p < 0.05$) low blood flow in the painful trapezius muscle as compared to the non-painful side in subjects in a series of increasing muscle contractions, each of 1 minute duration with 1 minute rest in between. Impairment of circulation of the trapezius muscles is an important consideration in persons with chronic neck pain. In a study in patients with fibromyalgia, findings supported the hypothesis that ischemia in the muscles can contribute to the cause of pain (Elvin, Sjösteen, Nilsson, & Kosek, 2006).

Trapezius muscle oxygenation has also been studied using aerobic exercise that did not directly involve the trapezius muscles. The study lead by Andersen and colleagues (2010) investigated tissue oxygenation of the trapezius muscles in women with chronic neck pain during and after bicycling at sub-maximal effort for 20 minutes. The researchers studied 17 female office workers with a mean age of 45.2 who had pain in the neck/shoulder region for more than 30 days during the previous year. The effects of cycling on the trapezius muscles in the neck pain group were compared to a control group with no pain (n=8; mean age=45.1). Post-exercise measurement of oxygenation using near-infrared spectroscopy found cycling to increase oxygenation of trapezius muscles in both groups, however slightly less in women with chronic neck pain. This study supports the beneficial response of cycling to increase oxygenation of resting painful muscles.

A study of the impact of bicycling on chronic neck pain (Andersen et al., 2008) revealed a 5mm reduction of the trapezius muscle pain immediately after 20 minutes of sub-maximal cycling ($p < 0.05$) using the 100-mm visual analog scale. The reduction of pain is hypothesized to be partly due to increased oxygenation and/or release of beta-endorphins. Goldfarb, Greensboro, Hatfield, Armstrong, & Potts (1990) found an increase in plasma beta-endorphin with a minimum exercise of 70% of VO2max for 15 on a bicycle. Beta-endorphins are neuropeptides that are secreted from the anterior pituitary gland (Sprouse-Blum, Smith, Sugai, & Parsa, 2010). They produce analgesia by binding to opioid receptors in the peripheral sensory nerve fibers.

A combination of metabolic and oxygenation of muscles may impact chronic neck pain. Further studies on the pathophysiology of neck pain are necessary to better understand the cause of neck pain. Effective interventions can be developed and tested based on a thorough understanding of the origin of and physiology of neck pain.

Impact of Neck Pain

Chronic neck pain impacts a person's quality of life and ability to perform activities of daily living. Additionally, chronic neck pain causes work absence and is the cause of significant healthcare dollars spent.

Quality of life. A prospective, cross-sectional analysis of data from the National Spine Network was examined to determine the impact of cervical axial and radicular symptoms on general health status (Daffner et al., 2003). Patients with neck and arm pain referable to the cervical spine were included (n = 1,809). Eight subscales of the SF-36 Health Survey were analyzed: bodily pain, vitality, general health, mental health, physical function, role physical, role emotional, and social function. Additionally, two summary scales were analyzed: physical component summary and mental component summary. Of the 1,809 patients who completed the questionnaire between 1998 and 2001, 65.4% of patients reported both neck and arm pain, 29.5% of patients reported neck pain only and 5.1% of patients reported arm pain only. Chronic pain for this study was defined as greater than 6 months, 56.9% of patients reported chronic pain. Patients with both neck and arm pain had lower SF-36 scores across seven of the eight subscales ($p = 0.049 – p < 0.013$; general health not significant) as compared to neck or arm pain only groups. Patients with axial neck pain only had significantly lower general health scores than patients with arm pain only ($p < 0.013$). Patients sixty years old and younger were significantly more impacted by pain in all eight subscales ($p = 0.05 – p < 0.001$). The mental component summary scores were significantly worse for patients with chronic symptoms than for patients with acute symptoms ($p < 0.001$).

In 2000, Fanuele et al. studied the SF-36 Physical Component Summary score of 17,774 patients with spinal conditions. The mean Physical Component Summary score for the general population is 50.0 ± 10.00. The researchers found the mean Physical Component Summary score for patients with a cervical or thoracic diagnosis was 32.1. They found no significant difference in the duration of symptoms. The study population was also stratified by comorbidities. It was found that as the number of comorbidities increased, the Physical Component Summary score decreased. In the study population 46.6% of the patients had at least one other non-spinal comorbidity. The researchers found that the mean Physical Component Summary score of patients with no comorbidity was 31.6, therefore, the spinal diagnosis is often responsible for decreased functional disability.

Further support for neck pain being negatively associated with health-related quality of life is demonstrated by Nolet et al. (2015). The study examined the association between neck pain severity and the mental component summary and physical component summary of the SF-36 questionnaire. The Chronic Pain Questionnaire and SF-36 questionnaire were completed by 1,100 randomly sampled Saskatchewan adults at baseline and 6-months later. The researchers found a negative gradient between intensity of neck pain and physical health related quality of life over the course of 6 months. Musculoskeletal comorbidities and depression were found to be the most important factors influencing the association between neck pain and the physical component summary score. However, there was no significant association between neck pain and mental component summary scores (p = .192).

Disability. The Neck Disability Index (NDI) and the Neck Pain and Disability Scale (NPDS) are two scales commonly used in the measurement of disability from neck pain. In a study of validity on these two instruments in patients with chronic non-traumatic neck pain, the researchers used the Problem Elicitation Technique (Chan Ci En, Clair, & Edmondston, 2009). The qualitative interviews with 20 patients with neck pain for greater than three months covered areas such as self-care, work, mobility, leisure activities, social activities, emotion, communication and sleep. The researchers identified the most common functional problems of individuals with neck pain were disturbed sleep, driving and lifting. Frustration was identified as the most common emotional problem.

Psychological factors. A team of researchers investigated the association between psychological states (anxiety, depression, kinesiophobia and catastrophizing) of 45 subjects with chronic neck pain and self-reported pain and disability (Dimitriadis, Kapreli, Strimpakos, & Oldham (2015). Anxiety was defined as inner turmoil. Depression was defined as a persistent low mood. Kinesiophobia was defined as the belief movement can cause more injury and pain. Catastrophizing was defined as an irrational thought of believing something is worse than it actually is. Neck pain intensity measured by a visual analog scale was significantly correlated with anxiety (p <0.05). Disability, measured by the Neck Disability Index, was significantly correlated with anxiety, depression and catastrophizing (p <0.05). Further analysis revealed that pain-induced disability can be significantly predicted by anxiety and catastrophizing ($p < 0.05$).

A study of psychological factors early in the onset of neck pain suggests that persistent anxiety and depression at baseline might be risk factors for a transition to chronic pain (Wirth, Humphreys & Peterson, 2016). The Bournemouth questionnaire was used to assess pain, disability with activities of daily living, disability with social activities, anxiety, depression, fear-avoidance and pain locus of control. Anxiety ($p = 0.013$) and depression ($p = 0.037$) were the most important psychological factors for self-perceived recovery in the first 3 months of a first episode of acute neck pain. Anxiety and depression in both studies were found to be important psychological factors in the predictor and management of pain and disability related to neck pain.

Loss of work time. Current diagnostic classification systems and variable tracking methods make it difficult to directly ascertain how much work time is lost as a result of neck pain. Côté et al. (2008) examined a cohort of claimants to the Ontario Workplace Safety & Insurance Board for the calendar year of 1998 and found the annual incidence of absenteeism involving neck pain was 30 per 10,000 full time equivalents or 11.3% of Ontario workers who received lost-time benefits. This study was limited to individuals who lost work time related to a workman's compensation claim and did not take into account loss of work time with a general sick day which would account for a incidence of work absenteeism secondary to neck pain.

Cost. Borghouts, Koes, & Vondeling (1999) completed a cost analysis of neck pain in The Netherlands in 1996. The total estimated cost of neck pain in 1996 was estimated to be $686.2 million. The costs were grouped as direct medical costs ($159.6 million) and indirect non-medical costs ($526.5). Direct costs included hospital care, medical procedures, medical specialists, ambulatory hospital care, general practice costs and paramedical care. Indirect costs included costs of absenteeism and costs of disability.

As a result of the physical, emotional and cost burdens of chronic neck pain, effective interventions are necessary to reduce the burden of neck pain.

Noninvasive Treatment for Neck Pain

An extensive review of the literature reveals a lack of evidence supporting a single most effective treatment of neck pain. However, many research studies support the use of a variety of conservative treatment options, including exercise, manipulation and acupuncture to reduce neck pain. Several studies support exercise in various forms such as flexibility, strength and endurance training and general exercise, to decrease pain and disability in patients with chronic neck pain (Andersen et al., 2008; Blangsted et al., 2008; Bonfort et al., 2001; Chiu, Lam & Hedley, 2004; Friedrich, Cermak, & Maderbacher, 1996; Jordan et al., 1998; Kjellman & Öberg, 2002).

Neck exercise and manipulation. In a large study by Jordan et al. (1998) 119 patients with chronic neck pain were randomized into three treatment groups: group training led by a physical therapist, individual physical therapy, and manipulative treatment by a chiropractor. All three treatment groups showed approximately a 50% reduction in pain based on a 0-10 Likert pain scale at the conclusion of the 6 week treatment period. There was no significant difference between the three groups at completion of treatment (p =0.44). All three groups showed continued improvement in pain scores at the 4 and 12 month follow up evaluations (p <0.05). The Copenhagen Neck Functional Disability Scale was used to measure disability levels for participants. All three groups showed a significant improvement in disability at the conclusion of the 6 week treatment period. There was no significant difference between groups (p =0.61). Disability improvements continued at the 4 and 12 month follow up evaluations as compared to baseline. Each of the three arms of the intervention included a 1.5 hour group education program focusing on understanding neck pain, functional anatomy of the neck, ergonomic principles, stress and the importance of self-help and exercise. The limitations of this study were that the research team was unable to determine whether the educational component or the exercise component of the intervention was responsible for the improved pain and disability.

Further support for exercise as a favorable treatment for chronic neck pain was demonstrated in a study by Bonfort et al. (2001) in which 191 patients with chronic neck pain were randomized into one of three groups: spinal manipulation with exercise, MedX rehabilitative neck exercise, or spinal manipulation only. There was no control group in this study. The spinal manipulation was performed by chiropractors. The exercise component of the spinal manipulation with exercise group was comprised of 45-minute supervised sessions of upper body aerobic warm-up, light stretching, and strengthening exercises. The strength exercises were performed using headgear lying flat on a table with variable weight attachments to increase weight resistance gradually over time. The MedX exercise group was supervised by a physical therapist and consisted of stretching, aerobic exercise, upper body strengthening and resistance exercises using the MedX cervical extension and rotation machines. All groups received education on a home exercise program using a rubber tubing device for resistive extension, flexion and rotation devices. All three groups showed significant reduction in pain (p= 0.12) and disability (p= 0.45) using a 0-10 pain scale and the Neck Disability Index immediately after the 11 week program. However, at the 12 month follow up evaluation, the researchers found that participants in both of the exercise groups, with or without spinal manipulation, improved the most. The study suggests that exercise is an important factor in reduction of pain and disability. The authors provided instruction on home exercise to all participants, however adherence to home exercise post intervention was not captured in follow-up evaluations, making it difficult to discern the effects continued exercise might have on the follow up results

Another study consisting of 145 patients with chronic neck pain were randomized into two groups to determine the efficacy of exercise (Chiu, Lam & Hedley, 2004). The exercise intervention was two training sessions per week for six weeks, consisting of activation of deep neck muscles and cervical strength training. The researchers found that at six weeks, participants in the exercise group had significant improvement in pain (p = 0.01), disability (p = 0.03), and isometric neck muscle strength in all six directions (p = 0.57-0.00). At the six month follow up, the difference between the exercise and control group for disability and isometric neck muscle strength was not statistically significant. Significant improvement in pain was maintained in the exercise group (p <0.001) at six months. The authors reported that the effect of exercise was less favorable at six months; however, there were no follow up data collected on participant continuation of exercise after conclusion of the six week intervention period. Further research is necessary to determine if patients change behavior after the intervention is completed.

The McKenzie method is used by physical therapists as a diagnostic tool and treatment modality for patients with mechanical problems of the spine. Treatment is based on mechanical and symptomatic reactions to repeated movements. The therapist trained in these techniques choose the exercises based on patient's symptoms. Kjellman and Öberg (2002) compared the McKenzie method to general exercises of the neck and shoulders and a control group. The general exercises targeted the neck and shoulders areas with the intention of increasing movement, strength and endurance of the cervical muscles. An exercise list was developed by a group of physical therapists and patient specific exercises could be chosen from the pre-determined list that was compiled through a consensus of the therapists. The control group received ultrasound administered at the lowest intensity to the superior portion of the trapezius muscles for 7 minutes on each side as well as limited arm motion home exercises. Seventy-seven patients were randomized into the three groups: McKenzie method, general exercises and control. The researchers found a decrease in neck pain ($p < 0.0001$) and neck disability ($p < 0.01$-0.001) for all three groups after treatment and further improvement in pain for the McKenzie treatment group and general exercise group at 6 months ($p < 0.05$). This study supports that exercise, including strength training, range of motion and endurance, is beneficial for reducing neck pain and disability from neck pain.

While several studies support various forms of exercise as viable treatment options for cervical pain, Friedrich, Cermak and Maderbacher (1996) conducted a study comparing therapist directed exercise versus giving patients brochures describing exercises for cervical and low back pain. Eighty-seven participants were randomized into two groups: physical therapist led treatment or instruction by brochure. Primary outcomes included quality of exercise performance, muscle status and pain relief. Two physical therapists and one physician were blinded to treatment groups and graded quality of exercise and muscle status. Muscle status was defined by the researchers as the combined sum of the deviations from normal for measurements of muscle strength and length. The strength of deep cervical flexors was assessed using a six-tier rating scale ranging from 5 to 0, with 5 indicating normal strength. The length of cervical muscles were assessed using a four-tier scale ranging from 0 to 3, with 0 indicating normal length and 3 indicating severe shortening. Pain was measured using a visual analog scale of 0-100. The researchers found that 45 of the 47 patients in the supervised group had improved their quality of exercise performance between baseline and follow up compared to only 19 of 40 patients in the brochure group performing better exercise at follow up as compared to baseline. The quality of exercise performance was correlated with both muscle status improvement ($p < .01$)

and pain relief (p < .01). This study is significant because it shows that exercise instruction is necessary by a trained therapist to optimize patient outcomes.

General aerobic exercise. In addition to exercise specific to the neck muscles, there is evidence that overall general fitness, including walking, may improve chronic neck pain. In a prospective study researchers looked for a relationship between incidence of neck pain and daily walking steps in 367 sedentary workers and found a correlation between daily walking steps and decreased incidence of neck pain (adjusted OR 0.86, 95% CI, 0.74-1.00). Their study showed that an increase in daily walking steps by 1,000 reduced the risk of neck pain by 14% (Sitthipornvorakul, Janwantanakul, & Lohsoonthorn, 2015). In another study, 549 office workers were randomized into a specific resistance training group, all-round physical exercise group or control group. Persons with pain in the neck/shoulder region who participated in the all-round physical exercise group (any exercise not specific to the neck or shoulder region including walking) were as effective as specific resistance training of the neck and shoulder region in reducing duration and intensity of neck and shoulder symptoms (p < 0.0001). Outcomes were measured using a modified version of the Nordic questionnaire and the work ability index (Blangsted, Søgaard, Hansen, Hannerz, & Sjøgaard, 2008).

Further support for decreased pain with aerobic exercise was shown by Andersen et al. (2008) in a randomized controlled trial of 48 women with chronic neck pain comparing strength training of the cervical muscles to general fitness training performed as leg bicycling with relaxed shoulders and a control group without physical activity. Decrease in pain was seen for the specific strength training group ($p < 0.01$) and general fitness group ($p < 0.05$). The general fitness group saw immediate reduction in pain on the Visual Analog Scale, whereas the strength training group saw a decrease in pain over time.

An aerobic exercise component combining other exercise activities with various types of aerobic exercise was studied by two independent research groups. In the first study, Stewart et al. (2007) randomized 134 people with chronic neck pain to an advice alone or an advice plus exercise group. Six week outcomes revealed exercise and advice together was more effective than advice alone for improving pain ($p = 0.005$), bothersomeness ($p = 0.003$) and function ($p = 0.006$). The type of aerobic exercise used in this study varied and duration of the aerobic exercise component per day was not reported. The aerobic exercise group performed stretches, functional activities, activities to build speed, endurance and coordination, and trunk and limb strengthening exercises. Each education session lasted 1 hour. A second study comparing a program of exercise to a pain education only group for chronic neck pain patients was conducted by Brage, Ris, Falla, Søgaard, & Juul-Kristensen (2015). The exercise group included aerobic training, balance/proprioceptive training, specific neck exercises and pain education for treatment with chronic pain. Participants were instructed to perform exercises twice daily and aerobic training every other day. The exercise plus pain education group was found to show a significant and larger pain reduction ($p = 0.002$) after 8 weeks than the pain education only group. These studies both included choice in exercises and they included aerobic exercise as an important component of the treatment protocol.

Several studies outside of the chronic neck pain literature indicate that walking interventions are associated with significant improvements in pain and self-reported functions in individuals with chronic musculoskeletal pain (Nichols & Glenn, 1994; Evck & Sonel, 2002; Fransen & McConnell, 2009; Tritilanunt & Wajanavisit, 2001). These studies investigated walking in chronic low back pain, osteoarthritis of the knee, and in people experiencing fibromyalgia. Various durations and intensities of exercise were studied. Walking has been found to have significant reductions in pain, however, it has been suggested that supervised interventions may improve adherence as opposed to home based interventions (Fransen & McConnell, 2009).

The research suggests that in addition to exercise specific to the neck muscles, general fitness is also beneficial for persons with neck pain. Further research is necessary to determine the quantity and type of exercise that is most efficacious.

Acupuncture. Additional forms of noninvasive treatment for neck pain have also shown to be efficacious. David et al. (1998) compared physical therapy with acupuncture in a study of 61 patients with chronic neck pain. A visual analogue scale of pain was used to measure neck pain at baseline, 6 weeks, and 6 months. At the completion of the 6 week treatment interval, both groups showed improvement of pain and there was no significant difference between the groups ($p = 0.18$). At the 6 month follow up, both groups continued to have mean pain scores lower than baseline. Neck disability was measured using the Northwick Park neck pain questionnaire. The mean for both groups was decreased at completion of treatment and six month follow up. There was no significant difference between treatment type ($p = 0.72$). It is suggested that physical therapy and acupuncture are both effective forms of treatment for neck pain.

Massage. Massage therapy is another form of conservative treatment for neck pain. In a randomized controlled trial comparing various doses of massage therapy, researchers found that two or three 60-minute massages per week were more effective in reducing pain and disability as compared to fewer or shorter massages (Sherman et al., 2014). The researchers randomized 228 individuals with chronic nonspecific neck pain into 6 groups: (1) 30 minute massage 2 times weekly, (2) 30 minute massage 3 times weekly, (3) 60 minute massage 1 time weekly, (4) 60 minute massage 2 times weekly, (5) 60 minute massage 3 times weekly, or (6) the control group being a 4 week period on a wait list. The Neck Disability Index was used to measure disability from neck pain and an 11-point Likert scale was used to measure pain intensity at baseline and at 5-weeks. The massage therapists were licensed with a minimum of 5 years of experience. They were able to use a broad variety of techniques within their time limits. The researchers found a significant reduction in neck pain in the 60 minute massage two times weekly ($p = .007$) and three times weekly ($p = .001$). Similarly, neck dysfunction was significantly improved with the 60 minute massage two times weekly group ($p = .04$) and three times weekly group ($p = .005$).

The review of noninvasive treatment methods of neck pain supports a variety of treatment methods providing benefit for persons experiencing neck pain. Exercise, manipulation, acupuncture and massage all have research to support their role in pain reduction. Exercise is the form of general fitness that needs to be explored further to determine the overall benefits specifically the type and duration of exercise to be most beneficial.

Exercise Adherence

A research study was conducted to investigate adherence to two home exercise interventions for women with chronic neck pain. Karlsson et al. (2014) randomized 57 women into two groups: a strength training group and a stretching group. The exercises were focused on neck and shoulder muscle groups. All participants were asked to do the exercise session three times per week for one year. An exercise diary was used to track exercise. Support was provided by phone or e-mail every four to eight weeks. Exercise adherence varied greatly in both groups throughout the one year training period. Both groups started with a mean exercise frequency of 2.5 times per week in the first month. At the 4 to 6 month follow up, the strength group was performing exercises a mean of 1.5-2.0 times per week. In the same time period the stretch group was performing exercises a mean of 2.0-2.5 times per week. In the twelfth month of the trial, both groups performed exercises a mean of less than 1.5 times per week, there was no significant difference between the completers in the groups ($p = 0.90$). Primary outcomes were pain intensity measured by an 11 point Numeric Rating Scale and disability using the Neck Disability Index. The researchers compared completers of exercise to non-completers of exercise in each group. Differences between groups and within groups were analyzed. The researchers found no differences between the groups in neck pain (p = 0.50-0.93) or disability (p = 0.50-0.71) at the 4-6 month follow-up or the 12 month follow-up. Participants were considered completers if they completed at least 8 consecutive weeks of exercise with a frequency of at least 1.5 times per week. Due to a lack of adequate power for statistical analysis, it was difficult to determine the statistical significance of the completers and non-completers within the groups; however, proportional data indicated at the 4-6 month follow-up, that 94% of the strength completers had a decrease in pain and 88% of the stretch completers had a decrease in pain. At 4-6 months, 40% of the strength non-completers had a decrease in pain and 50% of the stretch non-completers had a decrease in pain. The study suggests that although exercise is shown to be an effective form of treatment for neck pain, adherence levels to neck exercise are low.

Although the exercise adherence literature in chronic neck pain is limited, research has been done in various subsets of the chronic pain population. A cross-sectional study of 1,111 adults with osteoarthritis of the knee were assessed for meeting the aerobic component of the 2008 Physical Activity Guidelines for Americans (≥ 150 minutes/week moderate-to-vigorous-intensity activity lasting ≥ minutes). Dunlop et al. (2011) found the aerobic physical activity guidelines were only met by 12.9% of men and 7.7% of women with knee osteoarthritis. A substantial proportion of men and women (40.1% and 56.5%, respectively) were inactive, having completed zero moderate-to-vigorous activity that lasted 10 minutes or more during the 7 days. Another study examined data from a nationwide survey of older adults (N

= 543) with regard to chronic pain and exercise and found that chronic pain was significantly associated with difficulty exercising regularly (OR = 1.57, 95 % CI = 1.04-2.37) (Krein, Heisler, Piette, Butchart, & Kerr, 2007). The researchers also examined the impact of self-efficacy on the same population and found higher self-efficacy reduced the association between chronic pain and reporting difficulty exercising. This research suggests although compliance among exercise is low in individuals with chronic pain, promoting self-efficacy is a strategy which may help improve exercise adherence.

Barriers to Exercise

A large study in Sweden was conducted investigated the reasons for not adhering to physical activity referrals in both home based exercise and physical therapy (Leijon, Faskunger, Bendtsen, Festin & Nilsen, 2011). The patients were referred for physical activity for a variety of reasons. A three-month follow up of 4,867 patients who received physical activity referrals took place by telephone interviews (74%), postal questionnaires (14%), and questionnaires provided during routine visits (12%). Of these, 1,358 (28%) self-reported non-adherence to exercise at the three month follow-up. Among the older patients (>65 years of age), sickness and pain were the most common causes of non-adherence. Younger patients reported lack of time and economic factors as the most frequent causes of non-adherence. Low motivation was a more frequent cause of non-adherence for those prescribed home-based activities compared to those referred for facility-based activities.

A study conducted in Sweden exploring pain beliefs in participants with neck or back pain in relation to physical activity found one theme: fear of hurting the fragile body (Stenberg, Fjellman-Wiklund, & Ahlgern, 2014). Twelve participants (4 neck pain and 8 back pain) shared perceptions which resulted in 5 categories related to fear: (1) the mechanical body, (2) messages about activity, (3), experiences of pain and activity, (4) to be a good citizen, and (5) support to be active. Fear of harming the mechanical body was related to fear of tissue damage or loading too much on the body. Participants indicated they received contradictory messages about exercise and vague advice. Present or previous increases in pain with physical activity caused fear of engaging in additional activities. Fear of being a burden to employers or family was categorized as being a good citizen. Finally, participants were insecure about how to do the correct exercises or needed supervised instructions to alleviate fears of hurting the body. All participants in this study related fear of hurting the body to participation in physical activity.

In 2015, a qualitative research study was conducted to examine facilitators and barriers to exercise in patients with cervical spine pain (Scibilia & Pretzer-Aboff, 2015, unpublished data). A semi-structured, face-to-face interview study design was used. A convenience sample of ten adult participants was recruited from a suburban neurosurgery office. Participants' median age was 63 (range 50-74 years), 6 female and 4 male. The individuals had to be English speaking, at least 50 years or older and suffering from neck pain to be included in the study. Exclusion criteria included trauma to the neck or cervical cancer. Interviews were conducted in a location convenient for the participant and lasted approximately 1 hour. The interviews were guided by the following broad open-ended questions:

1. Tell me about your neck pain.
2. How does exercise make you feel? Physiologically? Emotionally?
3. What exactly do you do for exercise?
4. What motivates you to exercise?
5. What deters you from exercise?

Data collection and analysis were concurrent. Interviews were audio taped and transcribed verbatim with the participants' information de-identified. The raw data were broken down into codes line-by-line through an inductive process. The codes were organized into categories and seven themes evolved. Four themes related to motivational factors to exercise and three themes related to barriers to exercise. The four themes identified for motivational factors to participate in exercise included perceptions of increased age, increasing range of motion, decrease pain, and having an established regimen (Figure 6).

Perceptions of increased age were related to the participants' fears that getting older would result in tightening and stiffening of the muscles and joints, decreased agility, worsening pain and weight gain. One woman stated, "When you get older if you don't move, everything stops working." This motivated her to continue to exercise.

In addition, participants verbalized the benefits of increased range of motion of their neck as a result of exercising. Exercise was reported as having the effect of “loosening muscles,” keeping them “limber,” and “making it easier to move.” One participant reported, “The stiffness motivates me to do the stretching exercises.” Several participants reported that as the exercise reduces their pain they were motivated to continue exercising.

An established regimen was found to be an important aspect in facilitating motivation to exercise among most participants. Elements of an established routine included the therapist’s encouragement and pushing them during therapy as well as scheduling exercise to be part of their daily routine. One participant stated, “I set my mind on certain days that I am going to go to the gym and I put it in my calendar.”

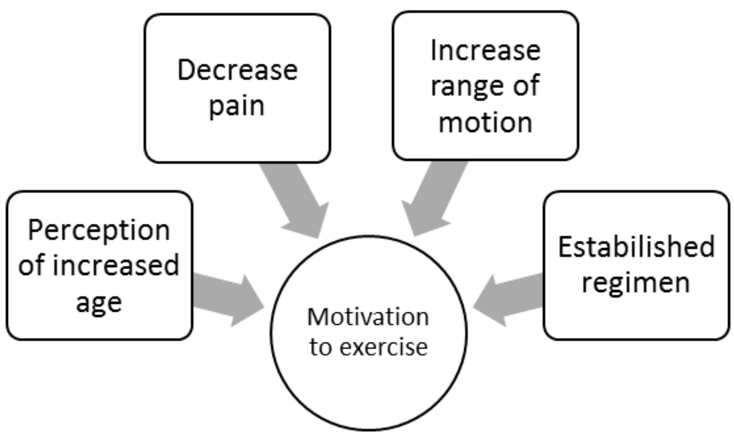

Figure 6. Motivational factors to participate in exercise.

Three major themes identified for barriers to exercise included lack of personal motivation, competing priorities, and fear of increased pain (Figure 7). Exercise was described by some as a “daunting task.” It got “tiresome” and “was inconvenient.” Participants reported lacking motivation and looking for excuses not to exercise. While others did not lack the motivation, they lacked the time. They reported taking care of others, including their children, grandchildren, and/or elderly parents. Some participants were still working full time jobs and found the busy schedule did not allow for exercise. With many competing priorities, exercise often came last. One participant stated, “I always put myself last. I never put my exercises on the calendar.” Finally, the fear of increased pain was identified as a barrier to exercising. Participants expressed “fear of pain” or “doing something wrong” to further damage their neck. One woman stated, “I feel like I will be in more pain if I do them.”

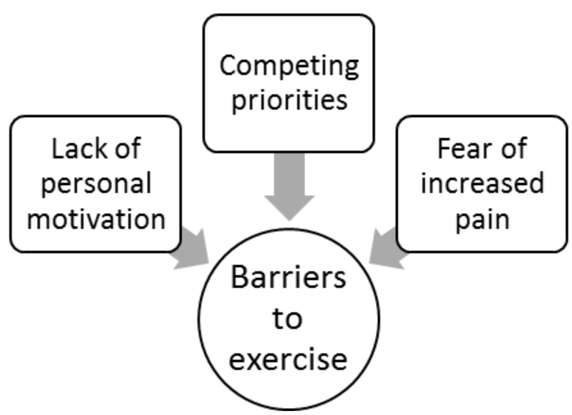

Figure 7. Barriers to participate in exercise.

The knowledge gained from this study has contributed to an understanding of patients suffering from neck pain and their barriers and facilitators to compliance with an exercise program. Previously discussed researchers have suggested that education about exercise for neck pain, along with establishing a regimen and motivational influences will help increase exercise compliance in individuals with neck pain. The themes identified from this study informed the motivational intervention for people with cervical pain in this dissertation research. The motivational aspects of the intervention was guided by Bandura's Theory of Self-Efficacy.

Bandura's Theory of Self-Efficacy and Social Cognitive Theory

An underlying assumption of the theory of self-efficacy (Bandura, 1986) is that people can influence their own behaviors. Self-efficacy refers to individuals' beliefs that they are capable of a behavior. Human functioning is viewed as a dynamic relationship between personal, behavioral and environmental factors. Four dimensions are viewed to influence persons' thoughts about their ability to execute a behavior: (1) direct experience of the effects produced by their actions, (2) vicarious experience, (3) judgements voiced by others, and (4) derivation of further knowledge of what they already know using rules of inference (Bandura, 1986).

The theory of self-efficacy is derived from Bandura's social cognitive theory. Bandura's early work focused on the social learning theory which originated in principles of learning including reinforcement, punishment, extinction and imitation of models (Bandura, 1977). Bandura further developed the social learning theory and placed a heavy focus on cognitive concepts. Through research on human behavior, Bandura (1986) transformed his work on the social learning theory into the social cognitive theory. The social cognitive theory is characterized by a reciprocal interaction between person, environment and behavior (Bandura, 1986). Within the social cognitive theory, Bandura outlines five capabilities of humans: symbolizing, vicarious, forethought, self-regulatory and self-reflective. Through these capabilities, humans have cognitive means that determine behavior.

The two main concepts of the theory of self-efficacy are self-efficacy and outcome expectations. Self-efficacy expectations are a person's beliefs about her ability to perform a task, whereas outcome expectations are a person's beliefs about what will happen after a task is completed (Resnick, 2014). These are two distinct concepts. For example, a person may believe her cervical pain would decrease after completion of an exercise program, however, she does not believe she is capable of participating in the exercise. Therefore, a distinction is made between the two concepts so that each may be targeted to influence behavior.

Bandura (1986) identified four variables that influence one's judgment about self-efficacy and outcome expectations. These are: enactive attainment, vicarious experience, verbal persuasion, and physiological state. Enactive attainment is the act of performing the behavior in question. Vicarious experience is witnessing another individual performing the activity. Verbal persuasion refers to one being told she is capable of mastering the behavior. Physiological state is the feedback an individual receives from the body on her ability to perform a behavior. For example, experiencing pain, fatigue or shortness of breath when exercising could influence a person's belief that she is able to exercise (self-efficacy) or if the exercise is beneficial (outcome expectations). Addressing these variables in the intervention will be important the motivation and sustainability of exercise prescribed to patients.

The theoretical underpinning of the motivational walking intervention used in this study are the concepts of Bandura's Social Cognitive Theory: person, behavior, and environment. Figure 8 shows the relationship between the concepts of the Social Cognitive Theory, the intervention and outcomes.

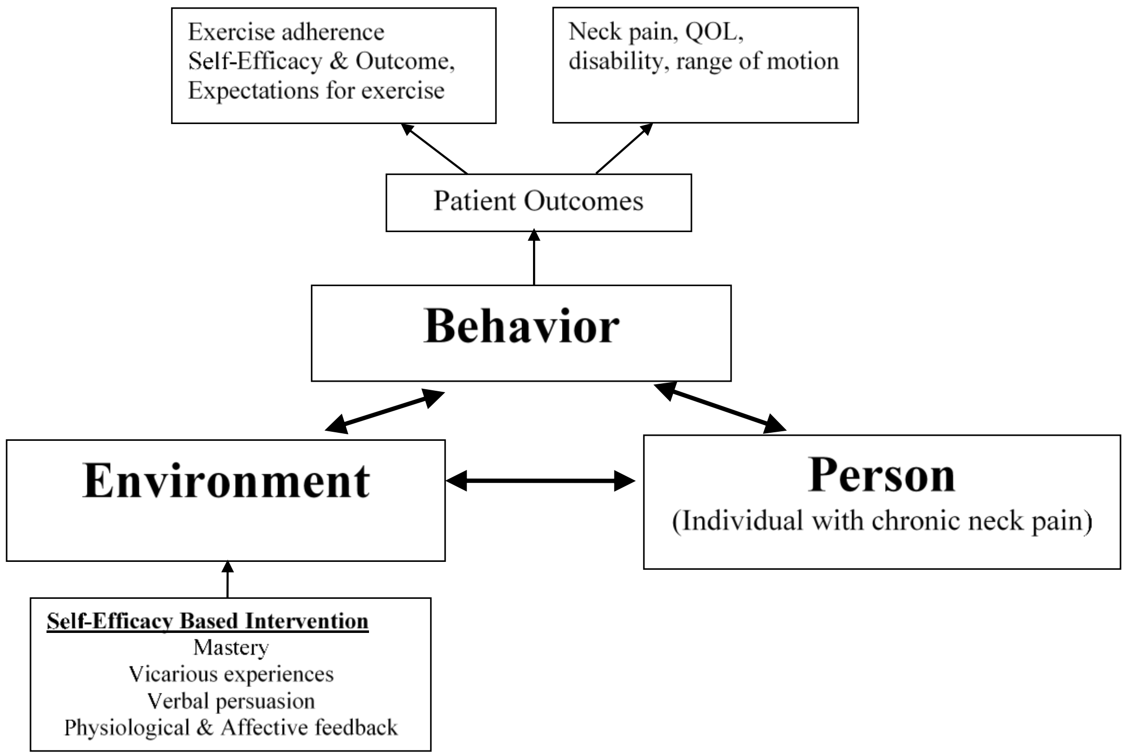

Figure 8. Relationship between Social Cognitive Theory, Intervention and Outcomes.

Behavior. The primary goal of this study was for participants to change behavior and adhere to recommended exercise. Social cognitive theory postulates that behavior choices made by an individual will be influenced by the dynamic interplay between the person (cognitive, affective, and biological events), environment (social influences and physical structures), and behavior. It is hypothesized that adherence to the behavior will result in changes in the measurable patient outcomes including exercise adherence, self-efficacy expectations for exercise, outcome expectations for exercise, pain, disability, quality of life and range of motion.

Person. Cognitive, affective and biological events are personal factors that influence an individual's decision to engage in activity (Bandura, 1977). People decide which activities they will engage in and strive to master. Relatively easy goals may be seen as insufficiently challenging to arouse much interest; moderately difficult goals can maintain high effort and generate satisfaction, while goals that are set well beyond one's reach can be discouraging (Bandura, 1977). Personality as well as other factors, such as pain (biological) and fear of exercise (affective), are influential in changing behavior.

Environment. Physical structures and social influences are environmental factors that interact reciprocally with person and behavior. The intervention was designed to address physical structures and act as a social influence to make stronger the individual's efficacy beliefs. The intervention includes the four variables Bandura (1986) identified as influencing one's judgment about self-efficacy and outcome expectations: mastery, vicarious experience, verbal persuasion, and physiological state. The four elements as it relates to the intervention will be discussed in chapter 3.

Bandura's Social Cognitive Theory provides the theoretical foundation for a person with chronic neck pain to make a decision to change behavior and engage in a walking intervention. The intervention was designed based on the Theory of Self-Efficacy as described to strengthen self-efficacy and outcome expectations to increase the likelihood of exercise adherence.

Summary

This chapter presented a thorough review of the literature including prevalence and etiology of neck pain, anatomy, pathophysiology, impact of neck pain, current treatment, adherence to exercise, barriers to exercise, the theory of self-efficacy, and social cognitive theory. This review of literature provides the scientific framework for a motivation based walking intervention for persons with chronic non-specific neck pain.

Chapter 2

METHODOLOGY

Introduction

This chapter will provide a description of the research methodology used in the study. This will include aims of the study, research design, outcomes, sample size, setting, details of the intervention, protection of human subjects, instrumentation, a plan for treatment fidelity, and data analysis.

Specific Aims

Chronic non-specific neck pain is a common condition that can negatively impact quality of life, range of motion and functional ability (Daffner et al., 2003; Fanuele et al., 2000; Nolet et al., 2015; Chan Ci En, Clair, & Edmondston, 2009). Researchers suggest that aerobic exercise may decrease chronic neck pain (Andersen et al., 2008; Blangsted et al., 2008). Pain reduction from aerobic exercise may be related to improved muscular oxygenation (Larsson et al., 1999) and elevated beta-endorphins (Goldfarb et al., 1990). Despite evidence of various forms of exercise to be beneficial for persons with chronic neck pain (Jordan et al., 1998; Kjellman & Öberg, 2002; Chiu et al., 2004), exercise adherence has been suboptimal (Karlsson et al.,2014; Krein et al., 2007). Lack of personal motivation, competing priorities and fear of increased pain have been found as barriers to exercise for persons with chronic pain (Scibilia & Pretzer-Aboff, 2015, unpublished data).

The specific aims of this study were to determine the impact and feasibility of a motivationally based walking intervention for people with chronic neck pain in the community setting.

Primary aims. The primary goals of this study were focused on exercise adherence, increasing self-efficacy beliefs for exercise, and improving pain, function, range of motion, and quality of life for participants with chronic non-specific neck pain.

1. Primary Aim: Examine the impact of a self-efficacy based walking intervention on participants' adherence to exercise.

Hypothesis: People with chronic neck pain who participate in a self-efficacy based walking intervention will demonstrate at least 80% adherence to the recommended exercise protocol.

2. Primary Aim: Examine the impact of a self-efficacy walking intervention on participants' self-efficacy and outcome expectations for exercise.

Hypothesis: People with chronic neck pain who participate in the self-efficacy based walking intervention will demonstrate increased self-efficacy expectations (Self-efficacy for Exercise Scale) and outcome expectations for exercise (Outcome Expectations for Exercise Scale).

3. Primary Aim: Test the impact of a self-efficacy walking intervention on participants' pain, function, range of motion and quality of life.

Hypothesis: People with chronic neck pain who participate in the self-efficacy based walking intervention will report a reduced level of neck pain (Numeric Pain

Rating Scale) and improved function (Neck Disability Index), range of motion (goniometer) and quality of life (36-Item Short Form Health Survey).

Secondary aim. The secondary goal of this study focused on the physiological effects of walking on the oxygenation of trapezius muscles in participants with chronic neck pain.

4. Secondary Aim: Examine the impact of the self-efficacy walking intervention on oxygenation to the trapezius muscles in participants with chronic neck pain.

Hypothesis: People who participate in the self-efficacy based walking intervention will experience increased oxygenation to the trapezius muscles (determined using near-infrared spectroscopy).

Design

This study used a single group, pretest, two post-test repeated measures design (Figure 9) to investigate the impact and feasibility of a motivation based walking intervention on exercise adherence, self-efficacy and outcome expectations for exercise, pain, function, quality of life, and oxygenation of trapezius muscles. The pretest (baseline) took place within one week prior to initiation of the four-week intervention. The post-test T2 took place within two days of completion of the four week intervention, and post-test T3 took place within two days of four weeks following T2.

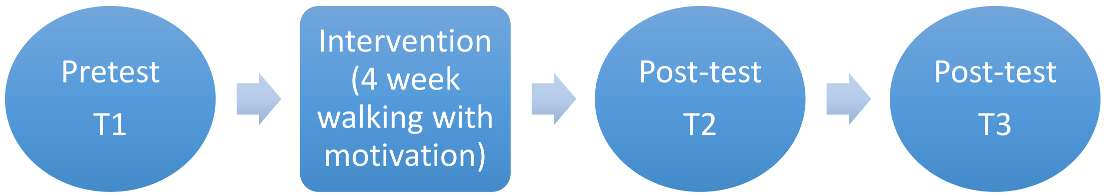

Figure 9. Study design.

Population and Sample

Setting. Participant recruitment took place in a private neurosurgical practice located in Southeastern New Jersey. The practice was comprised of one board-certified neurosurgeon specializing in the treatment of brain and spine disorders. The patient mix was approximately 80% spinal disorders and 20% brain disorders. The spine mix was approximately 50% cervical region and 50% lumbar region. The office serves approximately 25 new patients per week.

Participant recruitment took place through a flyer and by word of mouth from the researcher. The setting for data collection was at a location and time mutually agreed upon by the researcher and the participant.

Inclusion and exclusion criteria. Persons with chronic neck pain who met the following inclusion criteria were eligible to participate in the study: 1) aged 40 years or older; 2) has non-specific chronic neck pain (pain for greater than 3 months) (Bogduk, 2003); 3) can speak and understand English; and 4) can walk without an assistive device.

Individuals were to be excluded from the study if they had: 1) trauma to the neck (i.e. fracture or ligament damage); 2) a history of cancer of the cervical spine (determined by verbally asking); 3) were undergoing treatment for chronic neck pain at the start of the study (i.e. physical therapy, chiropractic therapy, acupuncture, etc.); 4) answered yes to any of the questions on the Exercise Readiness Questionnaire (Figure 10); and 5) did not have medical clearance.

1. Has a physician ever diagnosed you with a heart condition **and** indicated you should restrict your physical activity?	Yes/No
2. When you perform physical activity, do you feel pain in your chest?	Yes/No
3. When you were not engaging in physical activity, have you experienced chest pain in the past month?	Yes/No
4. Do you ever faint or get dizzy and lose your balance?	Yes/No
5. Do you have an injury or orthopedic condition (such as back, hip or knee problem) that may worsen due to a change in your physical activity?	Yes/No
6. Do you have high blood pressure or a heart condition in which a physician is currently treating you with medication?	Yes/No
7. Are you pregnant?	Yes/No
8. Do you have insulin dependent diabetes?	Yes/No
9. Are you 69 years or older **and** not used to being very active?	Yes/No
10. Do you know of any other reason that you should not exercise or increase your physical activity?	Yes/No

Figure 10. Exercise Readiness Questionnaire. Adapted from “Revised Physical Activity Readiness Questionnaire,” by R. Adams, 1999, *Canadian Family Physician*, 45, p. 995.

Protection of Human Subjects

Approval to conduct the study was obtained from the IRB at the University of Delaware. Prior to participation in the study, all participants were informed verbally and in the written consent that participation in the study was voluntary and they could withdraw at any time without adverse consequences. The participants were also informed that their participation in the study was in no way connected to the investigators employment at the neurosurgical practice. If they decided not to participate in the study, it did not interfere in any way with the care they received from their health care providers.

The participants' confidentiality was maintained in the following manner: a) each subject was assigned an identification number; b) all data were coded with the participant identification numbers; and c) identifying information was stored on a password protected computer in a locked office and separate from the data.

Recruitment and Consent Process

A meeting with the neurosurgeon interested in the study took place to present study goals, procedures and inclusion and exclusion criteria. The physician (or designee) was requested to provide a study flyer (Appendix A) to each patient with chronic neck pain who met the inclusion criteria. Flyers were placed in the waiting room of the office practice. Interested persons were asked to contact the principal investigator directly or leave their contact information with the front desk staff for the investigator to call directly.

A conversation took place with potential participants to answer questions about the study, determine interest in participation, and pre-screen for eligibility. Pre-screening for eligibility included the following process: assessment of length of time with neck pain, assessment of neck trauma or cancer (verbally asking potential participant), and administration of the Readiness for Exercise Scale. If the participant answered yes to any of the questions on the Readiness for Exercise Scale, medical clearance was required from the person's primary care physician or cardiologist prior to enrollment in the study. If pre-screening was successful and the participant verbally agreed to participate in the study, a convenient time was scheduled to proceed.

Outcomes and Instrumentation

Exercise adherence. Exercise logs were used to monitor exercise adherence. Participants were asked to write down their daily minutes and indicate if walking occurred alone or with a companion. Fitbit one wireless activity trackers (Fitbit, Inc., 2016) were used to validate what participants wrote on exercise logs**.** The Fitbit One physical activity tracker is a 0.76" x 0.38" x 1.89" device which can be clipped to clothing or placed in a front pants pocket. An internal accelerometer measures motion which is aggregated into physical activity data (Cadmus-Bertram et al., 2015). Summary information is available on the tracker itself and data are wirelessly uploaded to a personalized website that displays minutes of activity.

Neck Disability Index. Functional disability related to neck pain was measured using the Neck Disability Index (NDI). The NDI is a 10-item self-report questionnaire that targets daily activities most affected by neck pain. The following are the categories measured on the NDI: pain intensity, personal care, lifting, work, headaches, concentration, sleeping, driving, reading, and recreation. Each category has six options to choose from ranging from no pain (score = 0) or activity not affected to severe pain (score = 5) and cannot do activity at all. The minimally clinically important difference for persons with non-specific neck pain is 3.5 (Pool, Ostelo, Hoving, Bouter & de Vet, 2007). There is sufficient test-retest reliability in patients with chronic neck pain ($r = 0.89$, $p \leq .05$) (Vernon & Mior, 1991). Validity has been established through patient feedback sessions and the NDI has been correlated with the visual analog scale ($r = 0.6$) and McGill Pain Questionnaire ($r = 0.69-0.70$) (Vernon & Mior, 1991).

Numeric Pain Rating Scale. Pain intensity was measured utilizing the Numeric Pain Rating Scale (NPRS). The NPRS is an 11-point Likert Scale utilizing whole integers from zero to ten. Participants were asked to give their pain a numerical rating on a scale of zero being no pain to ten being the worst pain imaginable. The minimal clinically important difference is reported to be 1 point (Salaffi et al., 2004) to 1.7 points (Farrer et al., 2001) in persons with chronic musculoskeletal pain. Reliability has been established in patients with chronic musculoskeletal pain ($r = 0.63-0.95$) (Salaffi et al., 2004; Farrer et al., 2001). Validity has been established through a strong relationship between the NPRS and the Visual Analog Scale ($r = 0.94$) (Salaffi et al., 2004).

Cervical Range of Motion Device. The cervical range of motion device (CROM) is a cervical goniometer which measures flexion, extension, lateral flexion and rotation of the neck. Intra- and interreliability have been established with an intraclass correlation coefficient range of 0.73 to 0.95 (Capuano-Pucci, Rheult, & Aukai, 1991). Validity for cervical flexion-extension (Pearson $r > 0.97$) and lateral flexion (Pearson $r > 0.82$) has been established by comparison to radiographic films (Tousignant et al., 2002).

Global Perceived Effect Scale. The Global Perceived Effect of the independent variable was measured. The Global Perceived Effect (GPE) Scale is a 5-point Likert Scale ranging from patient perception of no change (score = 0) or much worse (score of -2) to very much improved (score of +2). Reliability has been established in chronic pain (r = 0.90-0.99) (Kamper et al., 2009). Correlation between change in pain and disability and GPE was above 0.5, however the GPE was found to be significantly affected by current health status (Kamper et al., 2009).

Self-Efficacy for Exercise Scale. The Self-Efficacy for Exercise Scale (SEE) focuses on self-efficacy expectations related to the ability to continue exercising in the face of barriers to exercise. The scale is a nine-item instrument with responses ranging from not confident (0) to confident (10). Reliability has been established in older adults related to aerobic exercise ($\alpha = 0.92$). Validity has been established through SF-12 subscale scores significantly predicting SEE scores ($p < 0.05$). Individuals with better physical and mental health were more likely to have stronger self-efficacy expectations (Resnick & Jenkins, 2000).

Outcome Expectations for Exercise Scale. Outcome expectations are measures using a nine-item Likert scale designed to identify older adults with low outcome expectations for exercise (Resnick et al., 2000). Five of the items reflect physical benefits of exercise and four items focus on mental health benefits. Respondents were asked to respond to statements with a range of strongly agree (1) to strongly disagree (5) with the stated outcomes or benefits of exercising. When tested in older adults, there was support for internal consistency ($\alpha = .89$). Validity was significantly related to exercise behavior, ($\beta = 0.31$ $p<0.05$), physical health ($\beta = 0.27$, $p = 0.001$) and self-efficacy expectations ($\beta = 0.17$, $p = .025$)

Fear-Avoidance Beliefs Questionnaire. The fear-avoidance beliefs are about how physical activity and work affect pain. The scale is a 16-item seven-point Likert scale. Five items reflect pain and physical activities, the remainder of the items assess how work affects pain. Reliability and validity were tested for patients with low back pain (Waddell et al., 1993). Test-retest reliability was high with an internal consistency alpha of 0.88 and 0.77 for work and physical activity, respectively.

Social Support for Exercise Survey. The social support for exercise survey assesses the level of support individuals felt they were receiving from family and friends for exercise (Sallis et al., 1987). The scale is 13 items assessing support from family members and the same 13 items assessing support from friends. A six-point Likert Scale is used to reflect how often a family member or friend has engaged in supportive activities for exercising.

The 36-Item Short Form Health Survey (SF-36). The SF-36 measures eight health concepts: physical functioning, bodily pain, role limitations due to health problems, role limitations due to personal or emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions. There are 36 items in the survey. Respondents are asked to respond to statements in the various categories utilizing a variety of 2-item, 3-item, 5-item and 6-item scales. The survey was scored using the RAND-36 method (Hays & Morales, 2001). Each item is scored so that a high score indicates a favorable health state. Each item is scored on a 0 to 100 range. Reliability was established through internal consistency alpha coefficients ranging from 0.71 to 0.93. External construct validity was tested using various scales for each question. Various items in the scale were tested against the Nottingham Health Profile and Dartmouth COOP Functional Assessment Charts. All the correlations between the corresponding scales were significant and positive (VanderZee, Sanderman, Heyink & de Haes, 1996).

Near-infrared spectroscopy. The Artinis Portamon is a portable near-infrared spectroscopy unit that measures concentration of oxy-hemoglobin, deoxy-hemoglobin and total hemoglobin. Persons with chronic neck pain have been found to have low blood flow in painful trapezius muscles as compared to non-painful trapezius muscles (Larsson, Öberg, & Larsson, 1999). Therefore, higher peripheral muscle oxyhemoglobin values are more desirable. Near-infrared spectroscopy has been studied in isometric hand grip exercises to support reliability of local muscle oxygen consumption at rest as well as during exercise of a broad range of intensities to a uniform selected subject population (Van Beekvelt, Van Engelen, Wevers, Colier, 2002). Subjects were tested on three separate days and no differences were found in the O_2 consumption of selected skeletal muscle.

Self-efficacy Based Intervention

The motivational intervention was designed based on the four elements of Bandura's Theory of Self-Efficacy: mastery, vicarious experience, verbal persuasion, and physiological state (Figure 11).

Mastery. An Environmental Factors Questionnaire (Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997) was used to determine the safety and suitability of surrounding environment for exercise. Mastery of the intervention can only occur if the participant has an appropriate exercise environment and an understanding of the task recommended. An exercise plan will be constructed in partnership with the participant to address areas of concern and development of a plan for exercise adherence. Short term and long term exercise goals were identified with participants. Participants were also asked to demonstrate a shoulders down, relaxed posture they were taught to use while walking to ensure they mastered the walking posture.

Vicarious experience. Exercise plans were shared between participants to encourage others through vicarious experience. As participants were enrolled in the study, participants were placed in interactive web-based groups of six in which they could see exercise each other was completing and they had the opportunity to interact through posting messages.

Verbal persuasion. Verbal persuasion was enacted throughout the study. Education was given regarding the intervention and its benefits for pain. Motivation was provided during meetings and phone calls to provide encouragement and praise.

Physiological state. Follow-up phone calls gave the researcher an opportunity to address the participant's physiological state. Suggestions were made for optimizing exercise, for example if the participant was taking Motrin 800mg for pain, a recommendation was made to take the medication 1 hour prior to the planned exercise to gain maximum benefits from exercise. Helping participants utilize effective coping mechanisms to address their physical sensations can enhance their self-efficacy resulting in improved performance (Bandura, 1997).

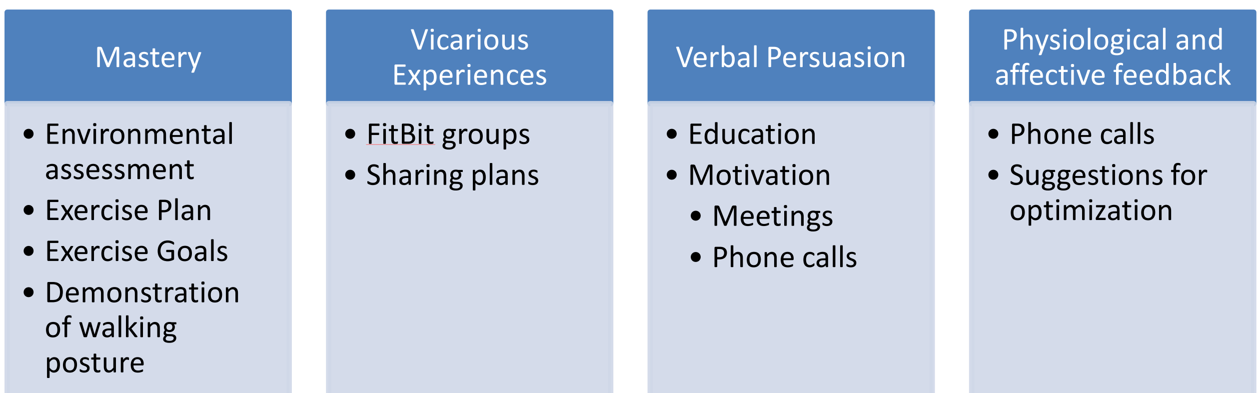

Figure 11. Self-efficacy based intervention.

Delivery of the Intervention

The researcher and participant met at a mutually agreed upon time. At the first meeting the informed consent was obtained (Appendix B) and the study commenced.

At the first meeting baseline data were obtained. Demographic data included: age, gender, race, education, occupation, employment status, cause, description and length of time with neck pain, treatment in the past, pain medication (type, strength, and frequency). The participant was given seven questionnaires including the Numeric Pain Rating Scale (Salaffi et al., 2004), Neck Disability Index (Vernon & Mior, 1991), Self-efficacy expectations Scale (Resnick & Jenkins, 2000), Outcome Expectations Scale (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000), Fear-Avoidance Beliefs Questionnaire (Waddell, Newton, Henderson, Somerville & Main, 1993), Social Support for Exercise Survey (Sallis, Grossman, Pinski, Patterson & Nader (1987) and the 36-Item Short Form Health Survey (Appendix C) (Ware & Sherbourne, 1992). Range of motion measurements were obtained using the cervical range of motion device (CROM) (Capuano-Pucci, Rheult, & Aukai, 1991). Additionally, resting muscle tissue oxygenation was measured using near-infrared spectroscopy (Artinis Portamon, Netherlands). Oxyhemoglobin, deoxyhemoglobin and total hemoglobin were measured on the transverse section of the upper trapezius muscle at the midpoint of the distance between acromion and the seventh vertebrae. The muscle oxygenation was measured at a distance of 3cm between device and light source to give an average light transmission depth of 1.5 – 2cm to ensure the site was in the trapezius muscle (Belardinelli, Barstow, Porszasz & Wasserman, 1995). There was no pain or discomfort associated with the use of the device.

The first meeting included instruction on the exercise expectations. The participants were asked to walk for 150 minutes per week at a submaximal pace but faster than a leisurely walk (U.S. Department of Health and Human Services, 2008). They were instructed the walking must be longer than 10 minute intervals. The participants were educated that they should feel slightly winded while walking. They were instructed on the use of the Borg Scale of Perceived Exertion (Appendix D) (Borg & Kaijser, 2006) and asked to stop exercising if they reach a rate of perceived exertion of 15 or greater. While walking the participants were asked to focus on relaxation of their neck muscles.

The motivationally-based walking intervention is a three step process focused on teaching and motivating and helping the persons with chronic neck pain set and achieve short term goals.

Step one. Establishing the philosophy. At the first meeting the participants were given an educational session regarding chronic neck pain and the benefits of exercise. The investigator used a booklet to reinforce concepts of pain, benefits of exercise and relaxation (Appendix E).

Step two. At the first meeting exercise goals and outcome expectations were established. Small achievable short-term goals were outlined. A plan for exercise adherence was discussed including a weekly exercise plan (Appendix E). Participants were given a Fitbit One Wireless Activity Tracker (Fitbit, Inc., 2016) and were instructed how to use the Fitbit to record steps and length of time in walking activity (Appendix F) (Cadmus-Bertram, Marcus, Patterson, Parker, Morey, 2015). An environmental factors questionnaire (Appendix G) (Sallis et al., 1997) was used to guide exercise as it relates to the safety and suitability of surrounding environment. Answers to the questionnaire helped inform suggestions for alternate exercise locations if safety concerns were identified. Physiological concerns were discussed, for example, questions about medication and the importance of hydration were presented. The participants were called within two to four days of the initial meeting to ascertain if there were any questions, that instructions were understood and to give positive feedback for progress made and to offer encouragement.

Step three. Motivation to exercise was a core component of the intervention. Motivation was carried out through each of the steps of the intervention beginning with education and goal setting. Ongoing recognition and reinforcement were provided after the initial meeting in the form of phone calls from the PI and from group members in the Fitbit groups set up on the online Fitbit application. Positive feelings toward education were emphasized as well as positive reinforcement related to performance in the form of feedback from other members of their Fitbit group. The participants were given guidance in dealing with unpleasant sensations that may be experienced. Each participant was called by the PI once per week for four weeks to encourage, reinforce and address barriers to exercise. One phone call was made to each participant between post-test and follow up testing. The participants were asked to record the minutes of exercise and exercise companion on an exercise log. Fitbit groups were monitored online by the PI for correct use and positive feedback (include phrases such as great job, keep up the good work, etc.) to the participants.

The post-test meeting took place within two days after four weeks of the motivational walking intervention was complete. Each of the seven questionnaires from the baseline testing were administered with the addition of the Global Perceived Effect Scale (Appendix H) assessing cervical pain, function, fear-avoidance beliefs, social support for exercise and quality of life. Range of motion and trapezius muscle oxygenation were also measured.

The final follow up meeting of the study occurred four weeks after the intervention post-test data were collected. Again, the eight questionnaires and range of motion and oxygenation measurements were administered. Additional questions addressing participants' thoughts of the program and impact on their lives and symptoms were discussed in an interview format using open ended questions.

Treatment Fidelity

Treatment fidelity refers to strategies to enhance reliability and validity of behavioral interventions (Bellg et al., 2004). This study included considerations in study design, provider training, treatment delivery, treatment receipt, and enactment of treatment with regard to treatment fidelity. Consideration of study design ensures the intervention is consistent with the underlying theory and the treatment dose is consistent between subjects. Provider training refers to ensuring the provider is adequately trained to deliver the intervention. Standardizing delivery of the intervention is important to deliver the protocol effectively as intended. Treatment receipt considers how the subject understands and interprets the intervention. Enactment of treatment pertains to the ability of the participants to carry out skills in their own environment. Table 1 outlines the treatment fidelity plan for the study.

Table 1

Treatment Fidelity Plan

Design	-Intervention is standardized using protocol. -Education is scripted and includes teaching tools. -Intervention is consistent with Bandura's Theory of Self-Efficacy.
Training	-Delivery of intervention is by one advanced practice nurse. -Training materials devised.
Delivery	-Each participant will be monitored for adherence for walking through a Fitbit (Fitbit, Inc., 2016) device and a walking log. -Intervention delivery time will be monitored for each participant.
Receipt	-A verbal quiz will be given after the education session to monitor for evidence of understanding.
Enactment	-Each participant will be asked to continue to monitor exercise compliance after the four week intervention for an additional four weeks through the Fitbit (Fitbit, Inc., 2016) and exercise log.

Data Analysis

In this single group repeated measures feasibility study, subjects completed baseline testing (T1) within the week prior to initiation of the four-week intervention. The post-test (T2) took place within two days of completion of the four-week intervention, and post-test (T3) took place within two days of four weeks following T2. The completion of T3 four weeks after completion of the intervention was supported by research indicating the effects of a behavioral intervention on exercise behaviors can be seen at four weeks after intervention (Oaten & Cheng, 2006). Intention to treat analysis was used; therefore, every participant enrolled in the study was included in the analysis.

Prior to analysis of the data, inspection of the descriptive statistics took place with attention to out-of-range values and outliers, missing data, and normality. On data identified as skewed (greater than ± 1), a box plot and stem leaf graph were generated to identify outliers. Outliers were assessed for incorrect data entry and failure to identify missing value codes. Skewed data were transformed using formulas (logarithm or square root) appropriate for negatively or positively skewed data. Transforming the data had no effect on normality, therefore the original form of the data was used (Kellar & Kelvin, 2013).

After data were cleaned, each outcome variable was evaluated separately at three time points (0, 1 & 2 month data collection times) using repeated measures analyses of variance (with the time factor represented as a repeated measure). The primary assumptions of repeated measures are multivariate normality and sphericity (Kellar & Kelvin, 2013). The first assumption is described above. It is important to note that the ANOVA is fairly robust against violation of multivariate normality (Kellar & Kelvin, 2013). The second assumption, sphericity, (at least in a single group design) assumes that the relationship between the various time points (or repeated measures) is similar. The Mauchly's Test of Sphericity was calculated for each variable with the use of SPSS version 24.0 computer program. If the Mauchly statistic is significant ($p <.05$) then sphericity cannot be assumed (Field, 2013). A significant Mauchly statistic indicates that the values from the same subject are not related; the ideal is a non-significant statistic. If data violate the sphericity assumption the validity of the F –ratio is affected (Field, 2013). To correct for a significant Mauchly's test of sphericity the conservative Greenhouse-Geisser correction calculations (calculated by SPSS) for F ratio was used.

The effect size was calculated using the partial eta squared (partial η^2) for each outcome measure (Kellar & Kelvin, 2013). The analysis of effect size was performed with the use of the SPSS 24.0 version computer program.

Frequencies were calculated to describe categorical variables; means and standard deviations were calculated to describe continuous variables, and median and ranges were calculated to describe continuous variables that were not normally distributed. Results of statistical analyses are illustrated in tables and figures, described in text, and organized by study hypothesis in chapter 4.

Sample Size Calculation

Based upon the assumption that the average correlation between participants' responses at each of the three time intervals (i.e., T1 through T3) would be approximately 0.50, it was determined that twenty people with non-specific neck pain is sufficient to detect a medium effect size (Cohen's d) of just over one-half (0.55) of one standard deviation (Bausell & Li, 2002). A total of 25 people with cervical neck pain were recruited to allow for a 25% drop out rate.

Summary

This chapter presented a description of the research methodology used in the study including specific aims, design, population and sample, protection of human subjects, recruitment and consent, outcomes and instrumentation, description of the intervention, treatment fidelity and data analysis.

Chapter 3

RESULTS

Introduction

The purpose of this single group repeated measure study was to test the feasibility and impact of a motivationally based walking intervention for people with chronic neck pain in a community setting. Primary study outcomes focused on exercise adherence, self-efficacy beliefs for exercise, pain, range of motion and quality of life. Secondary study outcomes focused on the physiological effects of walking on the oxygenation of trapezius muscles.

The results of this study are presented in this chapter. A description of participants is presented, followed by findings in relation to each research hypothesis. Data analysis was conducted using SPSS version 24.0.

Description of Participants

Twenty-five participants inquired about and were consented to participate in the study. Each participant met the inclusion criteria and was eligible to participate. Recruitment took place through word of mouth. Interested participants contacted the investigator and were screened for eligibility. Participants began the study on a rolling basis and once the target enrollment of 25 was met, no further participants were enrolled. The recruitment period started June 2016, after IRB approval process was completed, and lasted 2.5 months. All enrollees completed the eight week long study by the end of the first week of November 2016. All participants remained for the duration of the study.

Demographic data describing the characteristics of the 25 participants are presented in Table 2. The mean age of participants was 54.08 years (SD = 12.13). The majority were female (76%), Caucasian (96%), and worked full-time (60%). The mean years of chronic neck pain was 11.22 (SD = 9.73). There were no participants that used prescription pain medication. The majority of participants did not use over-the-counter pain medication (56%). Only one individual (4%) took over the counter pain medication on a daily basis, the remainder used pain mediation 1-2 times weekly (12%), or 1-2 times per month (28%). Pain medication included ibuprofen or acetaminophen.

Table 2

Demographic Characteristics of Participants with Neck Pain

	N	**%**	**Mean (SD)**	**Range**
Age (years)			54.08 (12.13)	40-79
Gender:				
Male	6	24		
Female	19	76		
Race:				
Caucasian	24	96		
Asian	1	4		
Work Status:				
Works full-time	15	60		
Works part-time	2	8		
Does not work	8	32		
Length of neck pain (years)			11.22 (9.73)	.5-30
Pain medication use:				
Daily	1	4		
Weekly	3	12		
Monthly	7	28		
Never	14	56		

SD = standard deviation

Data Cleaning and Screening

Data cleaning and screening were conducted using SPSS version 24.0. The database was inspected for missing or erroneously entered data. There were no out-of-range or missing values identified. The data were then inspected for outliers and normality. Outliers were identified by box plot and stem techniques. The outliers were removed from the analysis and after it was determined they did not have an effect on the interpretation of the data, they were included in the analysis. The Shapiro-Wilk test for normality was used to determine if the assumption of normality was met for each variable. When the assumption of normality was violated, the data were transformed using square root and logarithm techniques. Transforming data revealed no effect on normality or further skewing of the data, therefore the original data were used for analysis for each variable.

After the data were inspected and cleaned, each outcome variable was evaluated separately at three time points (baseline, 4-week and 8-week collection times) using repeated measures ANOVA (with time factor represented as repeated measure). All analyses were assessed for sphericity using the Mauchly's Test of Sphericity. If sphericity was not assumed, then the Greenhouse-Geisser correction for F-ratio was used. The effect size for each outcome was calculated using the partial eta squared (partial η^2). A small effect size is approximately 0.01, medium is approximately 0.06 and large effect size is approximately 0.14 (Field, 2013).

Primary Outcomes

The primary goals of this study were focused on exercise adherence and increasing self-efficacy beliefs for exercise; thereby, improving pain, function, range of motion, and quality of life for participants with chronic non-specific neck pain. The findings in relation to each research hypothesis are presented in the following tables and described below.

Hypothesis 1: *People with chronic neck pain who participate in a self-efficacy based walking intervention will demonstrate at least 80% adherence to the recommended exercise protocol.*

Twenty-four of the twenty-five consented participants were at least 80% adherent to the exercise protocol. The one participant that did not meet the threshold had a knee injury unrelated to the study in week 3. She was unable to complete the required walking for three consecutive weeks and then resumed in week 7. Her overall compliance rate was 47%. The overall mean percentage of compliance to exercise among the protocol adherent 24 participants was 96.58% (range = 82-100%). As shown in Figure 11, week 6 had the lowest exercise adherence at 93% and week was the highest at 99.8%. Six out of 25 participants consistently walked alone, 10 participants consistently walked with a partner and the remainder was mixed (approximately half of the time).

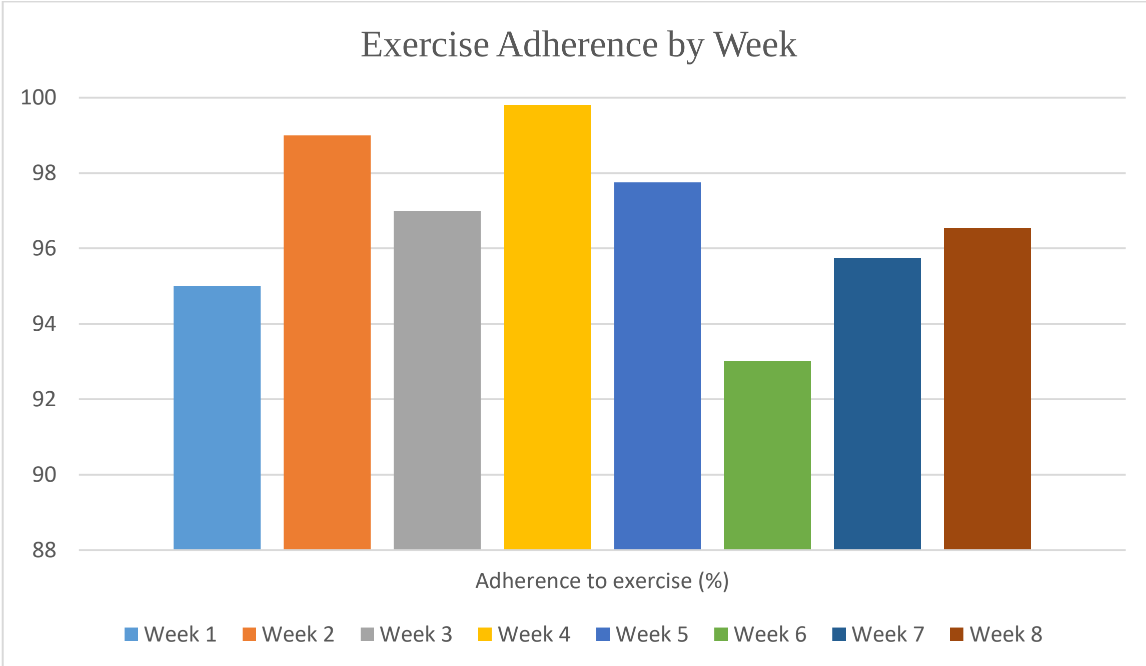

Figure 12. Percentage of overall weekly exercise adherence.

Fear of exercise due to pain and social support for exercise were two variables considered with exercise adherence. The Fear-Avoidance Beliefs Questionnaire measured the participants' fear of pain and avoidance of physical activity of because of their fear (Waddell et al., 1993). The fear-avoidance beliefs were analyzed using a one-way repeated measures ANOVA. The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 4.48$, $p = .11$. The walking intervention did not elicit statistically significant changes in fear-avoidance beliefs over time, $F(2, 48) = 1.54$, $p = .23$, partial $\eta^2 = .06$.

The Social Support for Exercise Survey was analyzed for both family and friends using a one-way repeated measures ANOVA. In the family component, the assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2)$ = 4.11, p = .13. The walking intervention did not elicit statistically significant changes in family support for exercise over time, $F(2, 48) = 2.87$, p = .07, partial η^2 = .11. Similarly, the social support for exercise friend component met the assumption of sphericity $\chi^2(2)$ = 3.98, p = .14, and was not statistically significant $F(2, 48) = .01$, p = .99, partial η^2 = .00.

Hypothesis 1 was supported by the study. Twenty-four out of twenty-five (96%) of the participants were at least 80% adherent to the exercise protocol. Fear-avoidance beliefs and social support for exercise were not significantly changed throughout the intervention and did not negatively impact exercise adherence for the participants.

Hypothesis 2: *People with chronic neck pain who participate in the self-efficacy based walking intervention will demonstrate increased self-efficacy expectations (Self-efficacy for Exercise Scale) and outcome expectations for exercise (Outcome Expectations for Exercise Scale).*

The total self-efficacy for exercise score was analyzed over the three time points using a one-way repeated measures ANOVA. The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2)$ = 2.50, p = .29. The walking intervention did not elicit statistically significant changes in self-efficacy over three time points, $F(2, 48) = .29$, p = .75, partial η^2 = .01.

The outcome expectations for exercise score was analyzed over the three time points using a one-way repeated measures ANOVA. The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 6.81$, $p = .03$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The walking intervention did not elicit statistically significant changes in outcome expectations for exercise over time, $F(1.59, 38.21) = .82$, $p = .42$, partial $\eta^2 = .03$.

Table 3

Repeated Measures ANOVA results – Hypothesis 2

N = 25	**Possible range of scores (# items)**	**Mean**	**SD**	***F***	***p***
Self-Efficacy for Exercise (SEE)	0-10 (9 items)			0.29	0.75
SEE T1		8.20	1.84		
SEE T2		8.25	1.85		
SEE T3		8.37	1.72		
Outcome Expectations for Exercise (OEE)[a]	1-5 (9 items)			.82[b]	0.42
OEE T1		1.44	0.39		
OEE T2		1.48	0.70		
OEE T3		1.34	0.62		

[a] lower scores more desirable; [b] sphericity violated, Greenhouse-Geisser correction applied

Hypothesis 2 was not supported by this study. The self-efficacy and outcome expectations for persons with chronic neck pain were not significantly affected. However, as shown in Table 3, participants began the study with overall favorable self-efficacy expectations for exercise (M = 8.20; SD = 1.84) and outcome expectations for exercise (M = 1.44; SD = 0.39).

Hypothesis 3: *People with chronic neck pain who participate in the self-efficacy based walking intervention will report a reduced level of neck pain (Numeric Pain Rating Scale) and improved function (Neck Disability Index), range of motion (goniometer) and quality of life (SF-36).*

A one-way repeated measures ANOVA was conducted to determine if there were statistically significant differences in current pain level over the course of the eight week walking intervention. The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 12.45$, $p = .002$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The walking intervention elicited statistically significant changes in current pain levels over time, $F(1.41, 33.85) = 8.47$, $p = .003$, partial $\eta^2 = .261$, with current pain decreasing from baseline (M = 2.52, SD = 2.29) to four weeks (M = 1.28, SD = 1.51) to eight weeks (M = 1.16, SD = 1.18). Post hoc analysis with a Bonferroni adjustment (Table 5) revealed that current pain levels was statistically significantly decreased from baseline to four weeks (M = 1.24, 95% CI [.14, 2.35], p = .024), and from baseline to eight weeks (M = 1.36, 95% CI [.30, 2.42], p = .009), but not from four weeks to eight weeks (M = .12, 95% CI [-.44, .68], p = 1.00). At four weeks, 18 out of 25 participants had a minimal clinically important difference of at least 1 point in pain reduction. At eight weeks, 19 out of 25 participants had a minimal clinically important difference of at least 1 point in pain reduction.

The worst pain level in the past 24 hours was also analyzed using a one-way repeated measures ANOVA. Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 1.13$, $p = .57$. The worst pain level in 24 hours was statistically significantly different at the different time points during the intervention, $F(2, 48) = 24.21$, $p < .001$, partial $\eta^2 = .50$, with worst pain in 24-hours decreasing from baseline (*M* = 4.64, *SD* = 2.29) to four weeks (*M* = 2.93, *SD* = 2.09) to eight weeks (*M* = 2.11, *SD* = 1.49). Post hoc analysis with a Bonferroni adjustment revealed that the worst pain level in 24 hours was significantly decreased from baseline to four weeks (*M* = 1.71, 95% CI [.80, 2.62], $p < .001$), and from baseline to eight weeks (*M* = 2.53, 95% CI [1.48, 3.59], $p < .001$), but not from four weeks to eight weeks (*M* = .83, 95% CI [-.06, 1.71], $p = .074$). At four weeks, 17 out of 25 participants had a minimal clinically important difference of at least 1 point in pain reduction. At eight weeks, 21 out of 25 participants had a minimal clinically important difference of at least 1 point in pain reduction.

Table 4

Repeated Measures ANOVA Results – Hypothesis 3

N = 25	Possible range of scores (# items)	Mean	SD	*F*	*p*
Numeric Pain Rating Scale (NPRS)[a], Current Pain	0-10 (1 item)			8.47[b]	0.003*
NPRS T1		2.52	2.29		
NPRS T2		1.28	1.51		
NPRS T3		1.16	1.18		
Numeric Pain Rating Scale (NPRS)[a], Worse Pain Level in Past 24 hours	1-10 (1 item)			24.21	<.001*
NPRS T1		4.64	2.29		
NPRS T2		2.93	2.09		
NPRS T3		2.11	1.49		
Neck Disability Index Scale (NDI)[a]	0-5 (10 items)			13.77	<.001*
NDI T1		10.20	6.33		
NDI T2		6.60	4.76		
NDI T3		5.88	4.64		

* significant at p<0.05 level; [a] lower scores more desirable; [b] sphericity violated, Greenhouse-Geisser correction applied

The total neck disability score was examined over the three time points using a one-way repeated measures ANOVA using the Neck Disability Index Scale, as shown in Table 4. Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 5.66$, $p = .06$. The neck disability score was significantly different at different time points during the intervention, $F(2, 48) = 13.77$, $p < .001$, partial $\eta^2 = .37$, with neck disability decreasing from baseline (*M* = 10.20, *SD* = 6.33) to 4-weeks (*M* = 6.60, *SD* = 4.76) to eight weeks (*M* = 5.88, *SD* =

4.64). Post hoc analysis with a Bonferroni adjustment revealed the neck disability was significantly decreased from baseline to four weeks (*M* = 3.60, 95% CI [1.42, 5.78], *p* = .001), and from baseline to eight weeks (*M* = 4.32, 95% CI [1.60, 7.04], *p* =.001), but not from four weeks to eight weeks (*M* = .72, 95% CI [-1.10, 2.54], *p* = .954. At four weeks, 12 out of 25 participants had at least a minimal clinically important difference of at least a 3 point reduction on the Neck Disability Index Scale. At eight weeks, 15 out of 25 participants had at least a minimal clinically important difference of at least a 3 point reduction on the Neck Disability Index Scale.

Table 5

Post Hoc Analysis with a Bonferroni Adjustment - Hypothesis 3

N = 25	**Mean difference**	***p***	**95% CI Lower bound**	**95% CI Upper bound**
Numeric Pain Rating Scale (NPRS), Current Pain				
NPRS T1-T2	1.24	.024*	.14	2.35
NPRS T1-T3	1.36	.009*	.30	2.42
NPRS T2-T3	0.12	1.00	-.44	.68
Numeric Pain Rating Scale (NPRS), Worse Pain Level in Past 24 hours				
NPRS T1-T2	1.71	<.001*	.80	2.62
NPRS T1-T3	2.53	<.001*	1.48	3.59
NPRS T2-T3	.83	.074	-.06	1.71
Neck Disability Index Scale (NDI)				
NDI T1-T2	3.60	.001*	1.42	5.78
NDI T1-T3	4.32	.001*	1.60	7.04
NDI T2-T3	.72	.954	-1.10	2.54
* significant at p<0.05 level				

Quality of life was measured using the 36-item Short Form Health Survey. The RAND method for scoring was used and scores are presented in eight health concepts: physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to emotional or personal problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions. Each of the eight subscales of the SF-36 were analyzed using a one-way repeated measures ANOVA as shown in Table 6.

Table 6

Repeated Measures ANOVA Results – Hypothesis 3 (Continued)

N = 25	**Possible Range of scores (# items)**	**Mean**	**SD**	***F***	***p***
SF-36 Subscales					
Physical Functioning	0-100 (10 items)			5.32[a]	.014*
SF-36 Phys Fun T1		84.00	19.90		
SF-36 Phys Fun T2		87.00	17.44		
SF-36 Phys Fun T3		91.00	13.07		
Role functioning/physical	0-100 (4 items)			4.88[a]	.023*
SF-36 Role Fun/phys T1		73.00	38.81		
SF-36 Role Fun/phys T2		91.00	24.87		
SF-36 Role Fun/phys T3		88.00	22.96		
Role functioning/emotional	0-100 (3 items)			2.64	.099
SF-36 Role Fun/emotional T1		91.20	19.98		
SF-36 Role Fun/emotional T2		92.53	23.67		
SF-36 Role Fun/emotional T3		98.04	7.32		
Energy/fatigue	0-100 (4 items)			4.53	.016*
SF-36 Energy T1		63.28	17.45		

SF-36 Energy T2		69.04	14.58		
SF-36 Energy T3		69.68	13.43		
Emotional well-being	0-100 (5 items)			2.08	.136
SF-36 Emotional T1		78.72	12.15		
SF-36 Emotional T2		80.48	11.03		
SF-36 Emotional T3		82.40	9.87		
Social functioning	0-100 (2 items)			1.28	.289
SF-36 Social T1		95.20	9.04		
SF-36 Social T2		96.20	8.66		
SF-36 Social T3		98.20	5.33		
Pain	0-100 (2 items)			14.46	<.001*
SF-36 Pain T1		64.90	19.65		
SF-36 Pain T2		76.80	16.48		
SF-36 Pain T3		83.30	15.17		
General Health	0-100 (5 items)			0.34	0.716
SF-36 Gen Health T1		76.60	17.18		
SF-36 Gen Health T2		78.00	15.94		
SF-36 Gen Health T3		77.20	15.95		
* significant at p<0.05 level; [a] sphericity violated, Greenhouse-Geisser correction applied					

Physical functioning: The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 6.42$, $p = .040$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The physical functioning score was significantly different at different time points during the intervention, $F(1.61, 38.60) = 5.32$, $p = .014$, partial $\eta^2 = .18$, with physical functioning increasing from baseline (*M* = 84.00, *SD* = 19.90) to four weeks (*M* = 87.00, *SD* = 17.44) to 8-weeks (*M* = 91.00, *SD* = 13.07). Post hoc analysis with a Bonferroni adjustment (Table 7) revealed the physical functioning was significantly increased from baseline to eight weeks (*M* = -

7.00, 95% CI [-12.76, -1.25], p = .014), but not from baseline to four weeks (M = -3.00, 95% CI [-9.52, 3.52], p =.744) nor four weeks to eight weeks (M = -4.00, 95% CI [-8.07, .07], p = .055.

Role functioning/physical: The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 13.11$, $p = .001$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The role functioning (physical) score was significantly different at different time points during the intervention, $F(1.39, 33.46) = 4.88$, p =.023, partial $\eta^2 = .17$. Post hoc analysis with a Bonferroni adjustment did not reveal statistical significance in pairwise comparisons.

Role functioning/emotional: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 5.80$, $p = .055$. The walking intervention did not elicit statistically significant changes in role functioning (emotional) for exercise over time, $F(2, 48) = 2.64$, $p = .08$, partial $\eta^2 = .10$.

Energy/fatigue: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.28$, $p = .53$. The energy/fatigue score was significantly different at different time points during the intervention, $F(2, 48) = 4.53$, p =.016, partial $\eta^2 = .16$, with energy/fatigue increasing from baseline (M = 63.28, SD = 17.45) to four weeks (M = 69.04, SD = 14.58) to eight weeks (M = 69.68, SD = 13.43). Post hoc analysis with a Bonferroni adjustment revealed the energy/fatigue was statistically significantly increased from baseline to eight weeks (M = -6.40, 95% CI [-11.68, -1.12], p = .014), but not from baseline to four weeks (M = -5.76, 95% CI

[-12.10, .58], p =.084) and four weeks to eight weeks (M = -.64, 95% CI [-7.04, 5.76], p = 1.00.

Emotional well-being: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .69$, $p = .71$. The walking intervention did not elicit statistically significant changes in emotional well-being for exercise over time, $F(2, 48) = 2.08$, $p = .14$, partial $\eta^2 = .08$.

Social functioning: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 4.59$, $p = .10$. The walking intervention did not elicit statistically significant changes in social functioning for exercise over time, $F(2, 48) = 1.28$, $p = .29$, partial $\eta^2 = .05$.

Pain: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.87$, $p = .39$. The pain score was significantly different at different time points during the intervention, $F(2, 48) = 14.46$, $p < .001$, partial $\eta^2 = .38$, with the pain score improving from baseline (M = 64.90, SD = 19.65) to four weeks (M = 76.80, SD = 16.48) to eight weeks (M = 83.30, SD = 15.17). Post hoc analysis with a Bonferroni adjustment revealed the pain score was significantly increased from baseline to four weeks (M = -11.90, 95% CI [-20.80, -2.30], p = .006), and from baseline to eight weeks (M = -18.40, 95% CI [-28.37, -8.43], p <.001), but not from four weeks to eight weeks (M = -6.50, 95% CI [-14.29, 1.29], p = .126.

General health: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.13$, $p = .57$. The walking intervention did not elicit statistically significant changes in general health for exercise over time, $F(2, 48) = .34$, $p = .72$, partial $\eta^2 = .01$.

Table 7

Post Hoc Analysis with a Bonferroni Adjustment – Hypothesis 3 (Continued)

N = 25	**Mean difference**	***p***	**95% CI Lower bound**	**95% CI Upper bound**
SF-36 Subscales				
Physical Functioning				
SF-36 Phys Fun T1-T2	3.00	.744	-9.52	3.52
SF-36 Phys Fun T1-T3	-7.00	.014*	-12.76	-1.25
SF-36 Phys Fun T2-T3	-4.00	.055	-8.07	.07
Role functioning/physical				
SF-36 Role Fun/phys T1-T2	-18.00	.063	-36.77	.77
SF-36 Role Fun/phys T1-T3	-15.00	.121	-32.82	2.82
SF-36 Role Fun/phys T2-T3	3.00	1.00	-6.34	12.34
Energy/fatigue				
SF-36 Energy T1-T2	-5.76	.084	-12.10	.58
SF-36 Energy T1-T3	-6.40	.014*	-11.68	-1.12
SF-36 Energy T2-T3	-.64	1.00	-7.04	5.76
Pain				
SF-36 Pain T1-T2	-11.90	.006*	-20.80	-2.30
SF-36 Pain T1-T3	-18.40	<.001*	-28.37	-8.43
SF-36 Pain T2-T3	-6.50	.126	-14.29	1.29
* significant at p<0.05 level				

Repeated measures one-way ANOVA was used to determine if there were differences in range of motion measurements across the three time points. Cervical range of motion was measured for the following motions: flexion, extension, lateral flexion left, lateral flexion right, rotation left and rotation right (Table 8).

Table 8

Repeated Measures ANOVA Results – Hypothesis 3 (Continued)

N = 25	**Possible range of scores (# items)**	**Mean**	**SD**	***F***	***p***
Range of Motion Measurements					
Flexion	-			4.39	.018*
Flexion T1		47.28	10.88		
Flexion T2		50.72	12.99		
Flexion T3		55.08	13.16		
Extension	-			1.30	.281
Extension T1		49.28	16.90		
Extension T2		49.96	13.78		
Extension T3		46.60	11.78		
Lateral flexion left	-			2.05	.139
Lateral flexion left T1		32.48	8.78		
Lateral flexion left T2		34.72	8.41		
Lateral flexion left T3		34.36	8.85		
Lateral flexion right	-			5.48	.007*
Lateral flexion right T1		30.64	7.49		
Lateral flexion right T2		34.40	7.80		
Lateral flexion right T3		35.04	8.45		
Rotation left	-			3.54	.037*
Rotation left T1		47.20	9.61		
Rotation left T2		52.16	11.86		
Rotation left T3		51.92	10.81		
Rotation right	-			5.60	.007*
Rotation right T1		45.92	8.88		
Rotation right T2		50.00	8.04		
Rotation right T3		53.32	13.56		
* significant at p<0.05 level					

Flexion: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .09$, $p = .96$. The flexion score was significantly different at different time points during the intervention, $F(2, 48) = 4.39$, $p = .018$, partial $\eta^2 = .16$, with flexion increasing from baseline ($M = 47.28$, $SD = 10.88$) to four weeks ($M = 50.72$, $SD = 12.99$) to eight weeks ($M = 55.08$, $SD = 13.16$). Post hoc analysis with a Bonferroni adjustment (Table 9) revealed the flexion measurements were significantly increased from baseline to eight weeks ($M = -7.80$, 95% CI [-14.44, -1.16], $p = .018$), but not from baseline to four weeks ($M = -3.44$, 95% CI [-10.43, 3.55], $p = .653$) and four weeks to eight weeks ($M = -4.36$, 95% CI [-11.09, 2.37], $p = .325$.

Extension: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.763$, $p = .414$. The walking intervention did not elicit statistically significant changes in cervical extension over time, $F(2, 48) = 1.303$, $p = .281$, partial $\eta^2 = .052$.

Lateral flexion left: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .443$, $p = .801$. The walking intervention did not elicit statistically significant changes in left lateral flexion movement over time, $F(2, 48) = 2.053$, $p = .139$, partial $\eta^2 = .079$.

Lateral flexion right: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .646$, $p = .724$. The right lateral flexion measure was significantly different at different time points during the intervention, $F(2, 48) = 5.483$, $p = .007$, partial $\eta^2 = .186$, with right lateral flexion increasing from baseline (*M*

= 30.64, *SD* = 7.49) to 4-weeks (*M* = 34.40, *SD* = 7.80) to 8-weeks (*M* = 35.04, *SD* = 8.45). Post hoc analysis with a Bonferroni adjustment revealed the flexion measurements were statistically significantly increased from baseline to eight weeks (*M* = -4.40, 95% CI [-8.06, -.74], *p* = .015), but not from baseline to four weeks (*M* = -3.76, 95% CI [-7.73, .21], *p* = .067) and four weeks to eight weeks (*M* = -.64, 95% CI [-4.08, 2.80], *p* = 1.00.

Rotation left: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .23$, $p = .89$. The left rotation measure was significantly different at different time points during the intervention, $F(2, 48) = 3.54$, $p =.04$, partial $\eta^2 = .13$, with right lateral flexion increasing from baseline (*M* = 47.20, *SD* = 9.61) to four weeks (*M* = 52.16, *SD* = 11.86) and unchanged from four weeks to eight weeks (*M* = 51.92, *SD* = 10.81). Post hoc analysis with a Bonferroni adjustment did not reveal significance in pairwise comparisons.

Rotation right: The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = .950$, $p = .622$. The right rotation measure was significantly different at different time points during the intervention, $F(2, 48) = 5.60$, $p = .007$, partial $\eta^2 = .19$, with right rotation measure increasing from baseline (*M* = 45.92, *SD* = 8.88) to four weeks (*M* = 50.00, *SD* = 8.04) to eight weeks (*M* = 53.32, *SD* = 13.56). Post hoc analysis with a Bonferroni adjustment revealed the flexion measurements were significantly increased from baseline to eight weeks (*M* = -7.40, 95% CI [-13.41, -1.39], *p* = .012), but not from baseline to four weeks (*M* = -4.08, 95% CI [-9.18, 1.02], *p* = .151) and from four weeks to eight weeks (*M* = -3.32, 95% CI [-9.27, 2.63], *p* = .491).

Table 9

Post Hoc Analysis with a Bonferroni Adjustment – Hypothesis 3 (Continued)

N = 25	**Mean difference**	***p***	**95% CI Lower bound**	**95% CI Upper bound**
Range of Motion Measurements				
Flexion				
Flexion T1-T2	-3.44	.653	-10.43	3.55
Flexion T1-T3	-7.80	.018*	-14.44	-1.16
Flexion T2-T3	-4.36	.325	-11.09	2.37
Lateral flexion right				
Lateral flexion right T1-T2	-3.76	.067	-7.73	.21
Lateral flexion right T1-T3	-4.40	.015*	-8.06	-.74
Lateral flexion right T2-T3	-.64	1.00	-4.08	2.80
Rotation left				
Rotation left T1-T2	-4.96	.101	-10.63	.71
Rotation left T1-T3	-4.72	.087	-9.95	.51
Rotation left T2-T3	.24	1.00	-5.08	5.56
Rotation right				
Rotation right T1-T2	-4.08	.151	-9.18	1.02
Rotation right T1-T3	-7.40	.012*	-13.41	-1.39
Rotation right T2-T3	-3.32	.491	-9.27	2.63
* significant at p<0.05 level				

Hypothesis 3 was supported by the study. There was improvement in current pain as well as report of worst pain in the past 24 hours on the Numeric Pain Rating Scale. Neck disability was improved as measured by the overall score on the Neck Disability Index. Quality of life was measured according to eight subscales.

Improvement was significant in four of the eight subscales: physical functioning, role limitations due to physical functioning, energy/fatigue and pain. The subscales that did not show improvement included: role limitations due to emotional functioning, emotional well-being, social functioning, and general health. Lastly, range of motion was improved in four of the six neck movements: flexion, right lateral flexion, right rotation and left rotation. There was no improvement in extension or left lateral flexion.

Secondary Outcome

The secondary outcome of the study was to test the impact of the self-efficacy walking intervention on oxygenation to the trapezius muscles in participants with chronic neck pain.

Hypothesis 4: *People who participate in the self-efficacy based walking intervention will experience increased oxygenation (oxyhemoglobin) to the trapezius muscles (determined using near-infrared spectroscopy).*

Resting oxyhemoglobin was measured at each time point. The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 6.50$, $p = .04$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The walking intervention did not elicit statistically significant changes in resting oxygenated hemoglobin over time, $F(1.61, 38.52) = 1.219$, $p = .299$, partial $\eta^2 = .05$ (Table 10).

Table 10

Repeated Measures ANOVA Results – Hypothesis 4

	Possible range of scores (# items)	**Mean**	**SD**	***F***	***p***
Oxygenation Measurements					
Resting Oxyhemoglobin N = 25	-			1.22[a]	.299
Resting O_2Hb T1		3.99	6.82		
Resting O_2Hb T2		3.36	6.08		
Resting O_2Hb T3		5.84	9.27		
Oxyhemoglobin Exercise 1 N = 24	-			5.63	.007*
Exercise 1 O_2Hb T1		3.50	4.01		
Exercise 1 O_2Hb T2		4.84	6.08		
Exercise 1 O_2Hb T3		7.95	7.01		
Oxyhemoglobin Exercise 2 N = 24	-			4.25[a]	.031*
Exercise 2 O_2Hb T1		4.39	6.79		
Exercise 2 O_2Hb T2		3.27	2.83		
Exercise 2 O_2Hb T3		7.10	5.65		
Oxyhemoglobin Exercise 3 N = 24	-			1.47	.242
Exercise 3 O_2Hb T1		6.35	9.74		
Exercise 3 O_2Hb T2		5.12	5.65		
Exercise 3 O_2Hb T3		7.58	6.79		
* significant at $p<0.05$ level; [a]sphericity violated, Greenhouse-Geisser correction applied					

Oxyhemoglobin was then measured after the participants did maximum effort shoulder shrug exercises for intervals of one minute with one minute rest in-between. Measurements were taken immediately when each minute was complete. The most affected side was measured first. If the pain was reported to be equal on both sides, the person's dominant side was measured first. Each person completed three minutes of exercise. One participant was unable to do the exercises due to recent surgery, therefore the total participants included in the exercise portion of measurements was 24. The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.81$, $p = .40$. The oxyhemoglobin measurement after 1 minute of exercise was significantly different at different time points during the intervention, $F(2, 46) = 5.63$, $p = .007$, partial $\eta^2 = .20$, with oxyhemoglobin increasing from baseline ($M = 3.50$, $SD = 4.01$) to four weeks ($M = 4.84$, $SD = 6.09$) to eight weeks ($M = 7.95$, $SD = 7.01$). Post hoc analysis with a Bonferroni adjustment (Table 11) revealed oxyhemoglobin measurements were significantly increased from baseline to eight weeks ($M = -4.45$, 95% CI [-8.38, -.52], $p = .023$) and four weeks to eight weeks ($M = -3.11$, 95% CI [-6.18, -.04], $p = .046$), but not from baseline to four weeks ($M = -1.34$, 95% CI [-4.83, 2.15], $p = .996$).

A one-way repeated measures ANOVA was again conducted to determine if there were statistically significant differences in trapezius muscle oxygenation after 2 minutes of exercise. The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 7.50$, $p = .02$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.648$). The oxyhemoglobin measurement after 2 minutes of exercise was significantly different at different time points during the intervention, $F(1.55, 35.69) = 4.25$, $p = .03$, partial $\eta^2 = .16$, with oxyhemoglobin increasing from four weeks ($M = 4.39$, $SD = 6.79$) to eight weeks ($M = 7.10$, $SD = 5.65$). Post hoc analysis with a Bonferroni adjustment revealed the oxyhemoglobin measurements after 2 minutes of exercise were significantly increased from baseline to 8-weeks (M = -2.71, 95% CI [-5.20, -.21], p = .031) and from four weeks to eight weeks (M = -3.83, 95% CI [-7.40, -.26], p = .033), but not from baseline to four weeks (M = 1.13, 95% CI [-3.06, 5.31], p = 1.00).

A one-way repeated measures ANOVA was again conducted to determine if there were statistically significant differences in trapezius muscle oxygenation after 3 minutes of exercise The assumption of sphericity was met, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 1.66$, $p = .44$. The walking intervention did not elicit statistically significant changes in oxyhemoglobin after 3 minutes of exercise over time, $F(2, 46) = 1.47$, $p = .24$, partial $\eta^2 = .06$.

Table 11

Post Hoc Analysis with a Bonferroni Adjustment – Hypothesis 4

N = 24	**Mean difference**	***p***	**95% CI Lower bound**	**95% CI Upper bound**
Oxygenation Measurements				
Oxyhemoglobin Exercise 1				
Exercise 1 O_2Hb T1-T2	1.34	.996	-4.83	2.15
Exercise 1 O_2Hb T1-T3	-4.45	.023*	-8.38	-.52
Exercise 1 O_2Hb T2-T3	-3.11	.046*	-6.18	-.04
Oxyhemoglobin Exercise 2				
Exercise 2 O_2Hb T1-T2	1.13	1.00	-3.06	5.31
Exercise 2 O_2Hb T1-T3	-2.71	.031*	-5.20	-.21
Exercise 2 O_2Hb T2-T3	-3.83	.033*	-7.40	-.26
* significant at p<0.05 level				

Hypothesis 4 was partially supported by the study, as shown in Table 10. There were no significant changes in resting oxyhemoglobin at four or eight weeks. However, the oxyhemoglobin levels increased when exercising the trapezius muscles for one and two minutes after eight weeks of the walking intervention.

Treatment Fidelity Results

The elements of treatment fidelity outlined in chapter 3 were recorded using a spreadsheet.

Design. The education was delivered 100% of the time using a script. The education booklet was delivered to the participants at every initial meeting.

Provider training. The intervention was delivered by one researcher. The protocol manual and script was followed 100% of the time for each visit and telephone call.

Treatment delivery. The delivery of the intervention was recorded on a spreadsheet for all subjects. All initial visits were made within one week of the initial phone screening process. The intervention was delivered in the home of a participant 100% of the time. The initial visit lasted between 60 and 75 minutes. All participants were called within two to four days of the initial visit. Phone calls were completed weekly until the four week follow-up and lasted 3 to 5 minutes each. No phone calls were missed. The second meeting took place four weeks after the initial visit. All visits took place within two days of the four week mark. The four week follow up visits lasted between 40 and 60 minutes. One additional phone call was placed two weeks following the 2nd home visit and lasted approximately 3 to 5 minutes. The eight week follow-up was conducted within two days of the eight week mark and lasted 40 to 60 minutes.

Receipt of knowledge. The participants identified the exercise recommendation (150 minutes per week), minimum requirement to be given credit (at least 10 minute intervals), and described moderate intensity (faster than leisurely, slightly winded) at the initial meeting 100% of the time. Participants were also asked to demonstrate shoulders-down, relaxed neck muscle posture for walking during each initial visit.

Enactment of treatment. Each participant documented his/her exercise on the exercise log and wore the Fitbit for exercise for a total of eight weeks. There was 100% compliance with participants completing the logs and wearing the Fitbits. The data from the Fitbit were aggregated and monitored on Fitabase.com. The Fitbit data validated the exercise logs. The threshold for minimum adherence was 80% of the 150 minutes per week. There was 96% participant adherence above the minimal threshold. Of the completers, there was an overall walking adherence of 96.58%.

Summary

This chapter presented the results of the data analysis. Descriptive statistics of demographic data was described on the 25 participants. Descriptive statistics were presented in Table 2. A figure was used to illustrate exercise adherence. Tables were used to report repeated measure ANOVA results. Text was used to inform the reader as to whether the results support the hypotheses. Finally, the degree to which the intervention was actually implemented was discussed in terms of the treatment fidelity plan outlined for this study.

Chapter 4

DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

Introduction

The purpose of this study was to test the feasibility and impact of a motivational walking intervention for people with chronic neck pain in a community setting. The primary outcomes included exercise adherence, increasing self-efficacy beliefs and outcome expectations for exercise, decreasing pain, decreasing disability and quality of life and improving range of motion. Secondary outcomes included improving oxygenation of the trapezius muscles. This chapter presents a discussion of the study's findings, its feasibility and treatment fidelity, limitations and recommendations for future study.

Impact of Walking Intervention

Exercise adherence. A major finding of this study demonstrated that 24 out of 25 (96%) of the participants in this motivationally based walking intervention, based on Bandura's Theory of Self Efficacy, were at least 80% adherent to the exercise protocol. This finding was demonstrated on both the participants' exercise logs, and the data recorded by the Fitbit. These results were in contrast to several previous studies that described low exercise adherence in the treatment of chronic neck pain (Dunlop et al., 2011; Karlsson, Takala, Gerdle, & Larsson, 2014; Krein, Heisler, Piette, Butchart, & Kerr, 2007). However, the high level of adherence to exercise found in this study was consistent with other studies that tested motivational techniques to improve adherence and compliance in exercise interventions for people with chronic pain (Frih, Jellad, Boudoukhane, Rejeb, 2009; Resnick, 2002; Tse, Vong, & Tang, 2013). A possible explanation is that the walking intervention in this study was based on the motivational principles of Bandura's Theory of Self-Efficacy. Researchers have found low motivation to be a barrier to exercise adherence in people with chronic neck pain (Leijon, Faskunger, Bendtsen, Festin & Nilsen, 2011; Scibilia & Pretzer-Aboff, 2015, unpublished data); in this study the intervention addressed that barrier.

The motivational intervention was designed based on Bandura's Theory of Self-Efficacy. The concepts of the theory used to guide the intervention were mastery, vicarious experience, verbal persuasion and addressing physiological concerns. Mastery was successfully delivered at the baseline meeting through an environmental assessment, exercise planning, goal setting and demonstration of desired walking posture. Participants used the environmental assessment to identify alternate walking locations. For example, two participants walked in the air conditioned mall when the weather was not to their liking. Vicarious experience was intended to be achieved through Fitbit groups; however, the participants did not interact in their assigned friend groups as they were directed to in their orientation to the intervention. Vicarious experience was primarily through sharing of the investigator. For example, walking plans were shared with others to offer ideas for alternate walking locations. Verbal persuasion was successfully achieved throughout the study through education and motivation. Education and motivation was consistently delivered at meetings and phone calls throughout the study. Physiological and affective feedback was delivered during phone calls in which suggestions were made for hydration in the warm weather and walking in cooler hours of the day. During informal feedback after the sessions were complete, the participants indicated that the single most important element of the protocol was the Fitbit. They were aware the Fitbit data were being collected and monitored and they felt the objective tracking of the Fitbit held them accountable. The second most important factor they reported for exercise adherence was education. The 24 participants that were over 80% adherent had a mean compliance rate of 96.5% of the 150 minutes of moderate paced walking. The 150 minutes of moderate walking is in compliance with the 150 minutes of moderate activity per week as recommended by the CDC (U.S. Department of Health and Human Services, 2008).

Qualitative data preceding this study revealed that fear of movement and competing priorities were two themes identified as barriers to exercise, in addition to lack of motivation (Scibilia & Pretzer-Aboff, 2015, unpublished data). In this study, the Fear-Avoidance Beliefs Questionnaire and Social Support for Exercise Survey were analyzed to determine if there was an impact with the motivational walking intervention. Fear-avoidance beliefs and social support did not change over the course of the study. In this sample of people who volunteered to exercise, baseline scores for the fear-avoidance beliefs were low. There was no one in the study who voiced concern about exercising. Participants documented on their walking logs whether they walked alone or with a companion. Six out of 25 participants consistently walked alone, 10 participants consistently walked with a partner and the remainder was mixed (approximately half of the time). The walking patterns did not change throughout the course of the study. The six participants that consistently walked alone indicated through informal feedback that either they wanted to walk alone (felt it was relaxing) or walked at a time no one was available. No one reported on the Social Support for Exercise Scale that they received negative feedback from family or friends for exercising. In this study, fear was not a deterrent for exercise and family and friends were overall supportive and often participated in walking.

Self-efficacy for exercise and outcome expectations for exercise. There was no difference found in self-efficacy for exercise and outcome expectations for exercise between the three time points. Self-efficacy is measured on a scale of 1-10, with 10 being the most favorable response. The mean score for the self-efficacy at baseline was 8.20; therefore, the participants were beginning the study with favorable views on self-efficacy for exercise. Outcome expectations for exercise were measured using a 5-point Likert scale, with 1 being the most favorable response. The mean score for outcome expectations at baseline was 1.44. Like the self-efficacy for exercise, the sample had positive views on outcome expectations for exercise from the beginning. Both scales had a ceiling effect in which they started very favorable and did not have room for significant improvement. The sample had relatively low baseline neck pain and disability scores. Future studies with a sample of higher pain and disability at baseline, may elicit changes in other descriptors such as self-efficacy and outcome expectations.

Pain. The participants demonstrated reduction in neck pain as a result of the walking intervention. The reduction of pain was statistically significant on the

Numeric Pain Rating Scale (NPRS) as well as the pain subscale on the SF-36. Reduction in the current pain and worst pain level in the past 24 hours were ***clinically and statistically significant*** on the NPRS. A one point decrease in the NPRS scale indicates clinical significance (Salaffi et al., 2004). The current pain measurement decreased from a mean of 2.52 to 1.28 at the 4 week follow-up. The worst pain in 24 hour measurement decreased from a mean of 4.64 to 2.93 to 2.11 over the three time periods. This finding is clinically significant and important in that these individuals experienced less pain after adhering to the walking intervention.

The finding of reduced pain with walking is consistent with evidence of aerobic exercise improving chronic neck pain (Stewart et al., 2007; Brage, Ris, Falla, Søgaard, & Juul-Kristensen, 2015; Andersen et al., 2008; Blangsted, Søgaard, Hansen, Hannerz, & Sjøgaard, 2008). The studies to date included bicycling (Andersen et al., 2008) and general aerobic exercise that may include but are not limited to walking (Blangsted, Søgaard, Hansen, Hannerz, & Sjøgaard, 2008; Stewart et al., 2007; Brage, Ris, Falla, Søgaard, & Juul-Kristensen, 2015).

Disability. The participants demonstrated a statistically and clinically significant reduction in disability. The overall disability was measured by the Neck Disability Index and also the physical functioning and physical role functioning subscales of the SF-36. The clinically significant reduction in disability is 3.5 for non-specific neck pain (Pool et al., 2007). In this study, the mean disability scores decreased from 10.20 to 6.60 to 5.88 over the three time points indicating a clinically significant change. Similar to the pain measure, general aerobic exercise, not specific and limited to walking has been shown to improve disability (Blangsted, Søgaard, Hansen, Hannerz, & Sjøgaard, 2008; Stewart et al., 2007).

Quality of life. Out of the eight subscales of the SF-36, four showed statistical significance. The four scales of the quality of life survey that improved are pain, energy/fatigue, physical functioning and physical role functioning. The pain and physical role functioning and physical functioning are included above in the pain and disability categories.

Walking interventions have been studied in other chronic pain populations including low back pain, osteoarthritis of the knees and fibromyalgia (Nichols & Glenn, 1994; Evck & Sonel, 2002; Fransen & McConnell, 2009; Tritilanunt & Wajanavisit, 2001). Researchers have shown persons with chronic pain have had significant improvements in pain and self-reported functions. The findings of this study including decreased neck pain, improved disability and improved quality of life are consistent with walking interventions in different patient populations.

Range of motion. Statistical significance was found in four out of the six range of motion measurements. This finding is clinically significant; as pain is reduced, individuals are having better movement in their neck. Pain is a protective mechanism of the body and generally restricts movement. There are no studies found that have correlated aerobic exercise and range of motion of the neck.

Neck muscle oxygenation. Oxygenation of the neck muscles was measured using the oxyhemoglobin measurement using near infrared spectroscopy. There was no statistical difference in resting measurements in the three time points; however, after eight weeks of walking stressing the trapezius muscles through maximum effort shoulder shrug exercise using 2kg weights showed improvement in the oxyhemoglobin after 1 minute and 2 minute intervals of exercise.

This finding is significant because when stressing the trapezius muscles directly with maximum effort exercise, oxygen delivery was improved after eight weeks of walking. In a study by Shiro et al. (2012), women with neck pain had lower oxygenation and total hemoglobin of the trapezius muscles after 2 minutes of maximum effort isometric exercise of the trapezius muscles as compared to women with no neck pain. In this study, it is unable to be determined as to whether pain had a direct correlation with oxygenation. The pain was statistically improved at four weeks; however, the oxygenation was not statistically improved until eight weeks. From clinical experience, it may be a similar phenomenon as to the picture lagging behind the presentation of the patient. It has been hypothesized that increased oxygenation and/or release of beta-endorphins with exercise are contributing factors to reducing neck pain (Andersen et al., 2008). It is unclear as to whether or not the increased oxygenation is directly contributing to reduction of pain; however, the study supports that walking is related to increased oxyhemoglobin in the trapezius muscles with exercise.

Aerobic exercise in the form of bicycling has been found to increase oxygenation to the trapezius muscles (Anderson et al., 2010). In this study, the oxyhemoglobin was not measured after aerobic exercise. Future studies including continuous monitoring or measurement immediately after walking can ascertain whether walking has the same effect on the oxygenation. Further studies on the pathophysiology of neck pain are necessary to better understand the cause of neck pain. Effective interventions can be developed and tested based on a thorough understanding of the origin of and physiology of neck pain.

Feasibility

A major focus of this study was to establish the feasibility of implementing this type of intervention in a community setting. There are eight general areas of focus that have been identified to be addressed by feasibility studies: acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing (Bowen et al., 2009).

Acceptability focuses on how the recipients react to the intervention. In this study the recipients verbalized overall satisfaction with the intervention. The Global Perceived Effect Scale measured their overall perceived effect of the intervention on pain, disability and health. There were no negative responses on any of the measurements. At the completion of eight weeks, 21 out of 25 participants had a positive perceived effect on pain, 18 out of 25 had a positive perceived effect on disability, and 23 out of 25 participants had a positive perceived effect on overall health. The remainder of the participants perceived no change.

Demand refers to the extent the new process is likely to be used and the expressed interest in the idea. The qualitative research study used to inform this study indicated that lack of personal motivation was a barrier for exercise for persons with chronic neck pain (Scibilia & Pretzer-Aboff, 2015, unpublished data), therefore the intervention was motivationally based and built on Bandura's Theory of Self-Efficacy. The investigator discussed the study flyer with five potential patients with chronic neck pain. Each person consented to participation and all further subjects heard of the study through word of mouth and approached the investigator to participate. All 25 participants were enrolled within 2.5 months and although three additional persons contacted the investigator to participate, enrollment was stopped at 25. Of the first 25 participants who expressed interest in the study, 100% consented to participate. None of the participants were actively seeking treatment for the chronic pain.

Implementation concerns the extent to which the intervention can be fully delivered as planned. In this study, a protocol was developed to deliver the intervention consistently using a scripted manual. The intervention was delivered by the same interventionist who followed the protocol with regard to content that was disseminated during each visit and measurements obtained. The use of a written checklist allowed consistent delivery during the first, second and third visit. The checklist also assured that all devices, education sheets and questionnaires were brought to each home visit. During the visit, an appointment for the next point of contact being a phone call was arranged, assuring a convenient time. The technique was helpful in that all visits and phone calls were completed. There was 100% compliance with the in-person visits and phone calls.

Practicality explores the resources and commitment necessary to implement the intervention. The participants required a time commitment of 150 minutes per week of exercise to comply with the protocol. No subjects needed medical clearance to participate. Additional time commitments include 3 in-person meetings, the first averaging 60 to 75 minutes and the following two meetings averaging 40 to 60 minutes and 5 phone calls averaging 3 to 5 minutes each. The meetings took place in a location convenient for the participant. It allowed for easy access in terms of not having to arrange appointments around office space and may have contributed to the zero dropout rate for this study. Each participant was provided a Fitbit for the study. A limitation for future studies or translation to practice is the available funding for Fitbit devices. Future studies could explore the use of pedometers which can be purchased at a significantly lower price. Additionally, near-infrared spectroscopy units are expensive and not readily available for research or practice.

Adaptation refers to the extent the intervention performs when changes are made. In this study, the intervention was delivered by a single investigator. Improvements found in the outcomes may have been a result of the attention of the researcher and not the intervention, known as the Hawthorne Effect (Shadish, Cook, & Campbell, 2002). Further studies are necessary to determine if the replicability of the intervention is consistent with different interventionists. Additionally, the participants in this study willingly volunteered for an exercise intervention for chronic neck pain. Implementation of the intervention in a different population, not as willing to exercise, may have not produced the same adherence rates or outcomes.

Integration examines the extent the intervention can be sustainable in the community. The study showed that persons with chronic neck pain are capable of walking 150 minutes per week. Further research is necessary to determine if exercise adherence would be as favorable without the Fitbit. Furthermore, additional research is necessary to determine if one or two elements of Bandura's Theory of Self-Efficacy has a larger impact on adherence than the others. As clinician time is valuable, it is important to ascertain what the largest impact is using the least amount of time.

Expansion focuses on the potential success of an already-successful intervention in a different population. The US Department of Health and Human Services (2008) recommends 150 minutes of moderate activity per week, including walking, to gain a variety of health benefits including cardiovascular, pulmonary and psychological benefits. This study focused on expanding walking as the moderate activity for 150 minutes per week to the chronic neck pain population. Previous studies indicate exercise for persons with chronic neck pain is low (Dunlop et al., 2011; Karlsson, Takala, Gerdle, & Larsson, 2014; Krein, Heisler, Piette, Butchart, & Kerr, 2007); therefore, an intervention was designed based on Bandura's Theory of Self-Efficacy. A randomized controlled trial is necessary with sufficient sample size to test the impact of the intervention. Future research should include a diverse sample to increase generalizability of results.

Limited-efficacy testing refers to the promise of the intervention being successful. This study was designed to use a convenience sample to test the intervention in a limited way to determine if there is indication for a larger, randomized controlled trial. The results from this study are promising for exercise adherence, reduction in pain, improving disability, improving quality of life, improving range of motion and improving neck muscle oxygenation with exercise.

The results of this study warrant a randomized controlled trial to adequately test the impact of the intervention.

Strengths and Limitations of the Study

Examining the feasibility of the study helped to identify several strengths and limitations. Walking is an activity which most people are capable of. It is no cost and requires no specialized skill or equipment. People can have choices in their location, duration, time and companions during walking, which likely reduced attrition. Walking is easily implemented, practical and can be expanded to different populations. This study took a basic exercise and paired it with a motivational intervention to examine the rate of adherence to the recommended walking and the impact on persons with chronic neck pain.

Feasibility studies are used to determine whether an intervention is appropriate for further testing (Bowen et al., 2009). A repeated measure design is useful for a feasibility study because it excludes variability between subjects by comparing the group to itself over time (Shadish, Cook, Campbell, 2002). However, there are some limitations to the repeated measure design. The effect of history is a limitation, concerning what might have happened to participants if the treatment had not occurred (Shadish, Cook, Campbell, 2002). For this study, the data collection times were four weeks apart. It is possible that history did have an impact on some of the variables measured. There were no cases of mortality in this study; however, it is a consideration in a repeated measures design. Another limitation of repeated measures is test experience in which the participants anticipate the repeated questions. The anticipation of scales may impact the results (Shadish, Cook, & Campbell, 2002).

The use of a single interventionist in this study is both a strength and limitation. As noted in the implementation assessment of feasibility, one interventionist ensures a consistent adherence to the protocol. The delivery of education, motivational dialogue, and measurements were consistent throughout the study. Conversely, construct validity may have been hampered because the same person who administered the intervention also administered the outcome measures. To reduce the threat of construct validity of the measurement outcomes, the previous measures were not available to the researcher at the time each measurement took place.

The use of near infrared spectroscopy in this study is an objective measurement looking to understand tissue oxygenation and its relationship to chronic neck pain. One investigator used the measurement device allowing for consistency in the measurement technique for each participant. Care was taken with each measurement to shield ambient light from the detector; however, the possibility of interference of light is a limitation of using the device. An additional limitation of using near infrared spectroscopy includes the interference of other molecules, such as skin pigmentation, playing a role in detection from the sensors (Scheeren, Schober & Schwarte, 2012). In this study using a single-group repeated measures design excluded variability between groups.

In this small sample of 25 participants, generalizability is limited. All participants willingly volunteered for an exercise study, in most instances they sought out the researcher to participate. Rapid recruitment into this study was likely due to the unintended snowball effect where the subjects spread the work that such a study was in existence. As such, this may have resulted in a bias sample such that all participants were not adverse to exercising. The sample also lacked diversity; it is not a representative sample of people with chronic neck pain. The sample size also limits the statistical conclusion validity. The power was based on a medium effect size. For some variables, the effect size was small which could increase the Type 1 error.

Future Implications

This feasibility study showed promising results for a motivationally based walking intervention for persons with chronic neck pain. Motivational techniques guided by Bandura's Theory of Self-Efficacy have shown favorable results in adherence to exercise adherence. Walking 150 minutes per week is supported to have positive benefits on pain, disability, quality of life, range of motion and neck muscle oxygenation with exercise. Practitioners can use this evidence to inform patients of the benefits of walking. Practitioners should also consider implementation of motivation strategies to improve exercise adherence.

The significant findings in this study indicate the need for a randomized controlled trial with a sufficient sample size to test the impact of the intervention. Future research should include a diverse sample to increase generalizability of results. Additionally, future research can ascertain if various elements of the intervention provide more impact than others on the overall compliance rate. Future research studies can determine if the Fitbit is an essential element in the adherence. Possibly there is a less expensive device that can be used in place of the Fitbit. Continuing to study walking in persons with chronic neck pain can help determine the optimal dose of exercise. Furthermore, the positive outcomes associated with walking can be tested in other forms of aerobic exercise.

The use of near infrared technology has the potential to add significantly to the physiologic understanding of chronic neck pain. Future research can be done to better understand the microcirculation of chronic neck pain, including monitoring patients while walking to determine the oxygenation patterns. Near infrared spectroscopy can be used in future research to help determine the optimal intensity and dose of exercise to maximize trapezius muscle oxygenation.

The favorable outcomes of this feasibility study can be used to inform future studies to expand the understanding of chronic neck pain and optimize treatment methods.

Summary

This chapter presents a discussion of the study's findings, the feasibility of the study, strengths and limitations. This was followed by future implications.

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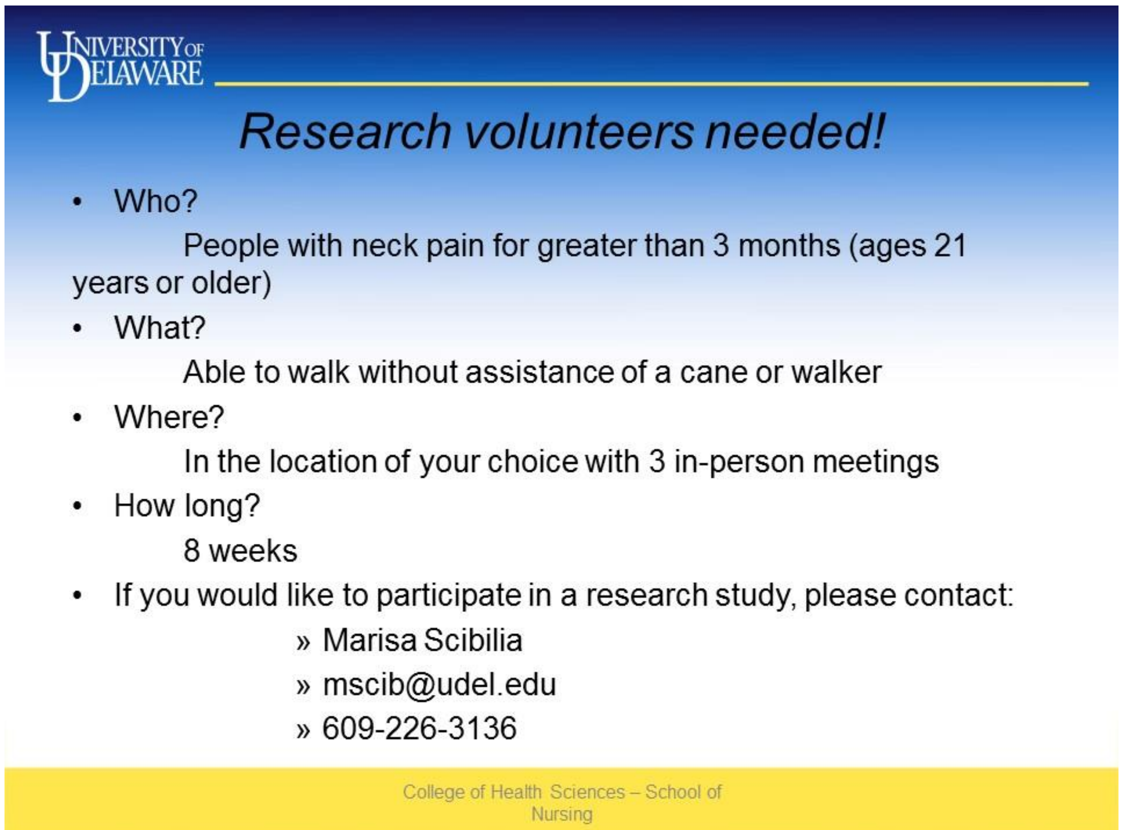
Appendix A

STUDY RECRUITMENT FLYER



Appendix B

INFORMED CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: Examining the impact and feasibility of a self-efficacy based walking intervention for persons with chronic non-specific neck pain.

Principal Investigator(s): Marisa Scibilia, MSN, APN
Ingrid Pretzer-Aboff, PhD, RN

You are being invited to participate in a research study. This consent form tells you about the study including its purpose, what you will be asked to do if you decide to take part, and the risks and benefits of being in the study. Please read the information below and ask us any questions you may have before you decide whether or not you agree to participate.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to determine the impact and feasibility of a motivationally-based walking intervention for people with chronic neck pain in the community setting. Primary goals of this study are focused on exercise adherence, increasing self-efficacy beliefs for exercise, and improving pain, function, range of motion, and quality of life. The secondary aim focuses on changes in oxygenation to the trapezius muscle as a result of the walking intervention.
The research study will be used for a student dissertation.
You will be one of approximately 30 participants in this study. You are being asked to participate because you have had neck pain for greater than 3 months, are 40 years of age or older, can speak and understand English and can walk without an assistive device. You would be excluded from the study if you had trauma to the neck (i.e. fracture or ligament damage), had cancer of the cervical spine, are currently undergoing treatment for chronic neck pain (such as physical therapy, chiropractic therapy or acupuncture), or answer yes to any questions on the Exercise Readiness Questionnaire without medical clearance.

WHAT WILL YOU BE ASKED TO DO?

As part of this study you will be asked to walk at moderate pace for a total of 150 minutes per week in time intervals of your choice (no less than 10 minutes per interval) wearing a FitBit One Activity tracker for a total of 8 weeks. The FitBit One Activity tracker will be worn during your dedicated walking time; it may be worn additionally throughout the day if you choose. You will be a member of a virtual group through FitBit.com. You have a choice to use your personal email address for registration at FitBit.com or a new email will be created for you to use. You may receive general emails from FitBit.com on occasion. Each member of the virtual group will have the same walking task and steps will be shared between members. You will be asked to also log your walking time and walking steps daily in a walking log for the duration of the 8 weeks.

Three in person meetings will occur at a location of your choice (lasting approximately 1 hour each) in which you will be asked to fill out questionnaires, cervical range of motion measurements will be obtained and oxygenation measurements of your trapezius muscles using near infrared spectroscopy will be obtained. During the oxygenation measurement test you will be asked to contract your trapezius muscles while wearing 2kg wrist weights for 1 minute followed by 2 minutes rest for a total of 3 times. Education will also take place at the first meeting.
A follow-up phone call will take place 2-4 days after the initial meeting to answer questions and provide guidance. Additionally, you must be responsive to weekly phone calls for the first four weeks and biweekly phone calls for the last 4 weeks. Each phone call will take approximately 10 minutes.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

Possible risks of participating in this research study include muscle pain, fatigue, dizziness, lightheadedness, shortness of breath, or fall. You will receive education on when to stop exercising and call your healthcare provider or emergency medical services.

WHAT IF YOU ARE INJURED DURING YOUR PARTICIPATION IN THE STUDY?

- You will stop exercising if you have a fall, feel the exercise is hard, have severe shortness of breath, chest pain, dizziness or lightheadedness. You will be instructed to call your healthcare provider or emergency medical services.
- If you are injured during research procedures, you will be offered first aid at no cost to you. If you need additional medical treatment, the cost of this treatment will be your responsibility or that of your third-party payer (for example, your health insurance). By signing this document, you are not waiving any rights that you may have if injury was the result of negligence of the university or its investigators.

WHAT ARE THE POTENTIAL BENEFITS?

You may benefit directly from this research study in that your neck pain may be decreased and your disability and quality of life may be improved. Range of motion and neck muscle oxygenation may also be improved.

The proposed studies will make a contribution to the knowledge of symptom management of chronic neck pain. Knowledge gained from this study could positively impact patients suffering with chronic cervical pain. An intervention focused on exercise adherence will add to knowledge of human motivation to change behavior. Additionally the impact of walking on neck pain will be examined. A little to no cost intervention could potentially provide benefits for improving pain, range of motion and quality of life. The results of the impact and feasibility study will assist in determining if a randomized controlled trial is warranted.

NEW INFORMATION THAT COULD AFFECT YOUR PARTICIPATION:

During the course of this study we may learn new information that could be important to you. This may include information that could cause you to change your mind about participating in the study. We will notify you as soon as possible if any new information becomes available.

HOW WILL CONFIDENTIALITY BE MAINTAINED? WHO MAY KNOW THAT YOU PARTICIPATED IN THIS RESEARCH?

Your survey responses and adherence to the exercise will be kept confidential. You will be assigned an identification number which will be assigned to all of your data. Your consent form and identifying information will be kept in a locked cabinet in a locked office separate from the data for a minimum of 3 years after the study is closed. Results will be reported as numbers in charts and graphs. The findings of this research study may be presented or published. If this happens, no information that gives your name or other details will be shared.

The confidentiality of your records will be protected to the extent permitted by law. Your research records may be viewed by the University of Delaware Institutional Review Board, which is a committee formally designated to approve, monitor, and review biomedical and behavioral research involving humans. Records relating to this research will be kept for at least three years after the research study has been completed.

WILL THERE BE ANY COSTS TO YOU FOR PARTICIPATING IN THIS RESEARCH?

There are no costs associated with you participating in the study.

WILL YOU RECEIVE ANY COMPENSATION FOR PARTICIPATION?

You will receive a Fitbit One Activity Tracker in appreciation for your time and participation in the study.

DO YOU HAVE TO TAKE PART IN THIS STUDY?

Taking part in this research study is entirely voluntary. You do not have to participate in this research. If you choose to take part, you have the right to stop at any time. If you decide not to participate or if you decide to stop taking part in the research at a later date, there will be no penalty or loss of benefits to which you are otherwise entitled. Your decision to stop participation, or not to participate, will not influence current or future relationships with the University of Delaware or your healthcare providers.

WHO SHOULD YOU CALL IF YOU HAVE QUESTIONS OR CONCERNS?

If you have any questions about this study, please contact the Principal Investigator, Marisa Scibilia, at (609) 226-3136 or mscib@udel.edu or the Supervising faculty, Ingrid Pretzer-Aboff, at 302-893-9504 or iaboff@udel.edu
If you have any questions or concerns about your rights as a research participant, you may contact the University of Delaware Institutional Review Board at hsrb-research@udel.edu or (302) 831-2137.

Your signature on this form means that: 1) you are at least 18 years old; 2) you have read and understand the information given in this form; 3) you have asked any questions you have about the research and the questions have been answered to your satisfaction; and 4) you accept the terms in the form and volunteer to participate in the study. You will be given a copy of this form to keep.

______________________________ ______________________________ __________

Printed Name of Participant | Signature of Participant | Date

______________________________ ______________________________ __________

Person Obtaining Consent (PRINTED NAME) | Person Obtaining Consent (SIGNATURE) | Date

<u>OPTIONAL</u> CONSENT TO BE CONTACTED FOR FUTURE STUDIES:

Do we have your permission to contact you regarding participation in future studies? Please write your initials next to your preferred choice.

________ YES ________ NO

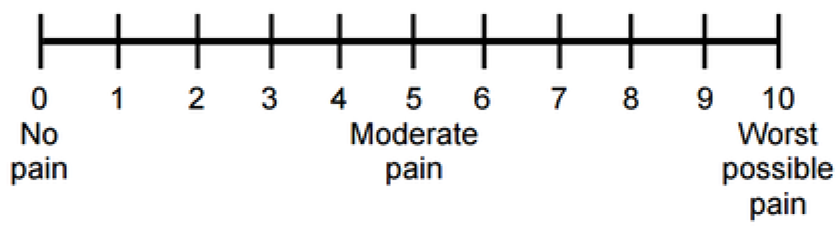
Appendix C

OUTCOME SCALES

Numeric Pain Rating Scale

Make three pain ratings, corresponding to current, best and worst pain experienced over the past 24 hours.   The average of the 3 ratings will be used to represent the level of pain over the previous 24 hours.

0–10 Numeric Pain Rating Scale



Current Pain: ______________

Best pain level in 24 hrs: _____________

Worst pain level in 24 hrs: ______________

Average:

____

(McCaffery & Beebe, 1989)

Neck Disability Index Scale

Participant ID________ Date________

This questionnaire is designed to give more information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the box that applies to you. We realize you may consider that two or more statements in any one section relate to you, but please just mark the box that most closely describes your problem.

Section 1: Pain intensity

- I have no pain at the moment
- The pain is very mild at the moment
- The pain is moderate at the moment
- The pain is fairly severe at the moment
- The pain is very severe at the moment
- The pain is the worst imaginable at the moment

Section 2: Personal Care (Washing, Dressing, etc.)

- I can look after myself normally without causing extra pain
- I can look after myself normally but it causes extra pain
- It is painful to look after myself and I am slow and careful
- I need some help but can manage most of my personal care
- I need help every day in most aspects of self care
- I do not get dressed, I was with difficulty and stay in bed

Section 3: Lifting

- I can lift heavy objects without extra pain
- I can lift heavy objects but it gives extra pain
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table
- Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned
- I can only lift very light weights
- I cannot lift anything

Section 4: Reading

- I can read as much as I want to with no pain in my neck
- I can read as much as I want to with slight pain in my neck
- I can read as much as I want with moderate pain in my neck
- I can’t read as much as I want because of moderate pain in my neck
- I can hardly read at all because of severe pain my neck
- I cannot read at all

Section 5: Headaches

- I have no headaches at all
- I have slight headaches, which come infrequently
- I have moderate headaches, which come infrequently
- I have moderate headaches, which come frequently
- I have severe headaches, which come frequently
- I have headaches almost all the time

Section 6: Concentration

- I can concentrate fully when I want to with no difficulty
- I can concentrate fully when I want to with slight difficulty
- I have a fair degree of difficulty in concentrating when I want to
- I have a lot of difficulty in concentrating when I want to
- I have a great deal of difficulty in concentrating when I want to
- I cannot concentrate at all

Section 7: Work

- I can do as much work as I want to
- I can only do my usual work, but no more
- I can do most of my usual work, but no more
- I cannot do my usual work
- I can hardly do any work at all
- I can’t do any work at all

Section 8: Driving

- I can drive my car without any neck pain
- I can drive my car as long as I want with slight pain in my neck
- I can drive my car as long as I want with moderate pain in my neck
- I can’t drive my car as long as I want because of moderate pain in my neck
- I can hardly drive at all because of severe pain in my neck
- I can’t drive my car at all

Section 9: Sleeping

- I have no trouble sleeping
- My sleep is slightly disturbed (less than 1hr sleepless)
- My sleep is mildly disturbed (1-2 hrs sleepless)

- My sleep is moderately disturbed (2-3 hrs sleepless)
- My sleep is greatly disturbed (3-5 hrs sleepless)
- My sleep is completely disturbed (5-7 hrs sleepless)

Section 10: Recreation

- I am able to engage in all my recreation activities with no neck pain at all
- I am able to engage in all my recreation activities, with some pain in my neck
- I am able to engage in most, but not all of my usual recreation activities because of pain in my neck
- I am able to engage in a few of my usual recreation activities because of pain in my neck
- I can hardly do any recreation activities because of pain in my neck
- I can't do any recreation activities at all

Score_______/50 Transform to percentage score x 100 = _________ % points

Scoring: For each section the total possible score is 5: if the first statement is marked the section score = 0, if the last statement is marked it = 5. If all ten sections are completed the score is calculated as follows:

Example: 16 (total scored)
50 (total possible score) x 100 = 32%

If one section is missed or not applicable the score is calculated:

16 (total scored)
45 (total possible score) x 100 = 35.5%

Minimum Detectable Change (90% confidence): 5 points or 10% points

(Vernon & Mior, 1991)

Self-efficacy Expectations for Exercise Scale

Participant ID__________ Date__________

How confident are you right now that you could exercise three times per week for 20 minutes if:

Not Confident Very Confident

1. The weather was bothering you	0 1 2 3 4 5 6 7 8 9 10
2. You were bored by the program or activity	0 1 2 3 4 5 6 7 8 9 10
3. You felt pain when exercising	0 1 2 3 4 5 6 7 8 9 10
4. You had to exercise alone	0 1 2 3 4 5 6 7 8 9 10
5. You did not enjoy it	0 1 2 3 4 5 6 7 8 9 10
6. You were too busy with other activities	0 1 2 3 4 5 6 7 8 9 10
7. You felt tired	0 1 2 3 4 5 6 7 8 9 10
8. You felt stressed	0 1 2 3 4 5 6 7 8 9 10
9. You felt depressed	0 1 2 3 4 5 6 7 8 9 10

Scored by calculating mean of questions answered.

Total Score_______

(Resnick & Jenkins, 2000)

Outcome Expectations for Exercise Scale

Participant ID_______ Date_______

Exercise …..

1. Makes me feel better physically

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

2. Makes my mood better in general

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

3. Helps me feel less tired

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

4. Makes my muscles stronger

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

5. Is an activity I enjoy doing

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

6. Gives me a sense of personal accomplishment

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

7. Makes me more alert mentally

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

8. Improves my endurance in performing my daily activities

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

9. Helps me to strengthen my bones

Strongly Disagree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1	2	3	4	5

Scored by calculating mean of questions answered.

Total Score__________

(Resnick et al., 2000)

Fear-Avoidance Beliefs Questionnaire

Participant ID_______ Date ________

For each statement please circle any number from 0 to 6 to say how much physical activities such as reading, carrying, walking or driving affect or would affect your neck pain.

Completely

Completely

disagree Unsure

agree

1) My pain was caused by physical activities…….. 0 1 2 3 4
5 6
2) Physical activity makes my pain worse………... 0 1 2 3 4
5 6
3) Physical activity might harm my neck………… 0 1 2 3 4
5 6
4) I should not do physical activities which
(might) make my pain worse…………………... 0 1 2 3 4
5 6
5) I cannot do physical activities which (might)
make my pain worse………………………….... 0 1 2 3 4
5 6

The following statements are about how your normal work affects or would affect your neck pain.

Completely

Completely disagree

Unsure agree

6) My pain was caused by my work or by
an accident at work…………………………….. 0 1 2 3 4
5 6

7) My work aggravated my pain………………….. 0 1 2 3 4
5 6

8) I have a claim for compensation for my pain….. 0 1 2 3 4
5 6

9) My work is too heavy for me………………….. 0 1 2 3 4
5 6

10) My work makes or would make my pain worse.. 0 1 2 3 4
5 6

11) My work might harm my neck………………… 0 1 2 3 4
5 6

12) I should not do my normal work with my present pain…………………………………….. 0 1 2 3 4
5 6

13) I cannot do my normal work with my present pain………………………………………….... 0 1 2 3 4
5 6

14) I cannot do my normal work till my pain is treated……………………………………... 0 1 2 3 4
5 6

15) I do not think that I will be back to my normal work within 3 months………………………….. 0 1 2 3 4
5 6

16) I do not think that I will ever be able to go back to work……………………………... 0 1 2 3 4
5 6

(Waddell et al, 1995)

Social Support and Exercise Survey

Participant ID_________ Date_________

Below is a list of things people might do or say to someone who is trying to exercise regularly. If you are not trying to exercise, then some of the questions may not apply to you, but please read and give an answer to every question.

Please rate each question **twice**. Under family, rate how often anyone living in your household has said or done what is described during the last three months. Under friends, rate how often your friends, acquaintances, or coworkers have said or done what is described during the last three months.

Please write one number from the following rating scale in each space:

None	Rarely	A few times	Often	Very Often	Does not apply
1	2	3	4	5	6

During the past three months, my family (or members of my household) or friends:

	Family	Friends
1. Exercised with me.	1.______	1.______
2. Offered to exercise with me.	2.______	2.______
3. Gave me helpful reminders to exercise ("are you going to exercise tonight?")	3.______	3.______
4. Gave me encouragement to stick with my exercise program	4.______	4.______
5. Changed their schedule so we could exercise together.	5.______	5.______
6. Discussed exercise with me.	6.______	6.______
7. Complained about the time I spend exercising.	7.______	7.______
8. Criticized me or made fun of me for exercising.	8.______	8.______
9. Gave me rewards for exercising (bought me something or gave me something I like.)	9.______	9.______

10. Planned for exercise on recreational outings

10.______ 10._______

11. Helped plan activities around my exercise.

11.______ 11._______

12. Asked me for ideas on how they can get more exercise.

12.______ 12._______

13. Talked about how much they like to exercise.

13.______ 13._______

Short Form-36 Health Survey

Participant ID _________ Date________

Please give the best one answer for each question.

GENERAL HEALTH: In general, would you say your health is:

☐ Excellent ☐ Very Good ☐ Good Fair ☐ Poor

Compared to one year ago, how would you rate your health in general now?

☐ Much better now than one year ago
☐ Somewhat better now than one year ago
☐ About the same
☐ Somewhat worse now than one year ago
☐ Much worse than one year ago

LIMITATIONS OF ACTIVITIES:

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Lifting or carrying groceries

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Climbing several flights of stairs

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Climbing one flight of stairs

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Bending, kneeling, or stooping

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Walking more than a mile
☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Walking several blocks
☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Walking one block
☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Bathing or dressing yourself
☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

PHYSICAL HEALTH PROBLEMS: During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities
☐ Yes ☐ No

Accomplished less than you would like
☐ Yes ☐ No

Were limited in the kind of work or other activities
☐ Yes ☐ No

Had difficulty performing the work or other activities (for example, it took extra effort)
☐ Yes ☐ No

EMOTIONAL HEALTH PROBLEMS: During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

Cut down the amount of time you spent on work or other activities
☐ Yes ☐ No

Accomplished less than you would like
☐ Yes ☐ No

Didn't do work or other activities as carefully as usual
☐ Yes ☐ No

SOCIAL ACTIVITIES: Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
☐ Not at all ☐ Slightly ☐ Moderately ☐ Severe ☐ Very Severe

PAIN: How much bodily pain have you had during the past 4 weeks?

☐ None ☐ Very Mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very Severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?
☐ Not at all ☐ A little bit ☐ Moderately ☐ Quite a bit ☐ Extremely

ENERGY AND EMOTIONS: These questions are about how you feel and how things have been with you during the last 4 weeks. For each question, please give the answer that comes closest to the way you have been feeling.

Did you feel full of pep?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good Bit of the Time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the Time

Have you been a very nervous person?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good Bit of the Time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the Time

Have you felt so down in the dumps that nothing could cheer you up?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good Bit of the Time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the Time

Have you felt calm and peaceful?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good Bit of the Time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the Time

Did you have a lot of energy?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good Bit of the Time

- Some of the time
- A little bit of the time
- None of the Time

Have you felt downhearted and blue?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Did you feel worn out?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Have you been a happy person?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Did you feel tired?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

SOCIAL ACTIVITIES: During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time

☐ None of the Time

GENERAL HEALTH: How true or false is each of the following statements for you?
I seem to get sick a little easier than other people
☐ Definitely true ☐ Mostly true ☐ Don't know ☐ Mostly false ☐ Definitely false

I am as healthy as anybody I know
☐ Definitely true ☐ Mostly true ☐ Don't know ☐ Mostly false ☐ Definitely false

I expect my health to get worse
☐ Definitely true ☐ Mostly true ☐ Don't know ☐ Mostly false ☐ Definitely false

My health is excellent
☐ Definitely true ☐ Mostly true ☐ Don't know ☐ Mostly false ☐ Definitely false

Score______________

(Hays & Morales, 2001)

Appendix D

BORG SCALE OF PERCEIVED EXERTION

6	No exertion at all
7	
	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

(Borg & Kaijser, 2006)

Appendix E

BOOKLET

Instructions, Education & Goals for Study

What to do?

- ✓ Walk 150 minutes per week at faster than a leisurely pace
- ✓ You should feel slightly winded while walking
- ✓ Walk at least 10 minutes at a time
- ✓ Wear Fitbit when during the day, remove at night
- ✓ Record time walked on exercise chart
- ✓ Focus on posture holding shoulders down and back while walking

STOP Exercising if…

- ➢ You reach 15 on the BORG scale (you feel the exercising is hard)
- ➢ You have severe shortness of breath*
- ➢ You have chest pain*
- ➢ You feel dizzy or lightheaded**

*****Call healthcare provider or emergency medical services for assistance.
**Drink water for dizziness or lightheadedness; if symptoms persist, call healthcare provider.

Why Walking?

A little bit about your neck…

- ❖ The neck has several bones, muscles, discs, ligaments, and nerves that can all cause pain.
- ❖ Often, the specific cause of neck pain is not known.
- ❖ Several muscles support and move the neck and are responsible for holding the head up.
- ❖ The average adult human head weighs 10-15 pounds.

Exercise and neck pain

- ❖ Studies have shown exercise to reduce neck pain
- ❖ There is not one best type of exercise that has been found to reduce neck pain
- ❖ The US Department of Health and Human Services recommends 150 minutes of moderate-intensity aerobic physical activity per week

Aerobic exercise and its benefits

- ❖ Brisk walking is considered aerobic exercise

- ❖ Aerobic exercise improves circulation and provides all muscles including your neck muscles with oxygen
- ❖ Well oxygenated muscles are thought to have less pain
- ❖ While exercising your brain secretes beta-endorphin which is a chemical that reduces pain
- ❖ Your neck has millions of nerve endings that respond to chemical and mechanical changes in your body.

My Personal Exercise Plan:

- ✓ I plan to walk ________ days per week for ________ minutes
- ✓ The best days for me to walk are:

  Sun Mon Tues Wed Thurs Fri Sat

- ✓ The location I plan to walk: ______________________________
- ✓ Alternate locations are: __________________________________
- ✓ People who may be available to walk with me:

  ____

Long term Exercise Goals:

- o I would like to reduce pain level to ______________________________
- o I would like to improve my ability to ____________________________
- o I believe exercise will help me to ________________________________
- o Other: ____
- o Other:____
- o Personal reward for achievement:________________________________

Appendix F

EXERCISE LOG

Please write down minutes of brisk walking each day.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total
Week 1 Date: Step goal: Time goal:								
Week 2 Date: Step goal: Time goal:								
Week 3 Date: Step goal: Time goal:								
Week 4 Date: Step goal: Time goal:								

Appendix G

PERCEIVED ENVIRONMENTS RELATED TO PHYSICAL ACTIVITY QUESTIONNAIRE

Participant ID_______ Date______

Neighborhood Environment:
Please indicate which of the following apply to your neighborhood. (yes = 1, no = 0)

a. Sidewalks
b. Heavy Traffic*
c. Hills*
d. street lights
e. dogs that are unattended*
f. enjoyable scenery
g. frequently see people walking or exercising
h. high crime*

*Indicates reverse score

How safe do you feel walking in your neighborhood during the day? (1 = very unsafe, 5 = very safe) _______

Is your neighborhood:

1. Residential
2. Mixed commercial and residential
3. Mainly commercial

Convenient Facilities
For each of these places where you can exercise, please indicate if it is on a frequently traveled route (e.g. to and from work) or within a 5-min drive from your work or home.

a. Aerobic dance studio
b. Basketball court
c. Beach or lake
d. Bike lane or trails
e. Golf course
f. Health spa/gym
g. Martial arts studio
h. Playing field (soccer, football)
i. Public park
j. Public recreation center
k. Racquetball/squash court
l. Running track
m. Skating rink
n. Swimming pool
o. Walking trails
p. Tennis courts

(Salis et al., 1997)

Appendix H

GLOBAL PERCEIVED EFFECT SCALE

Please circle one response.

1. What is your perceived change of pain as a result of the walking intervention?

much worse		no change		much improved
-2	-1	0	+1	+2

2. What is your perceived change of disability as a result of the walking intervention?

much worse		no change		much improved
-2	-1	0	+1	+2

3. What is your perceived change of overall health as a result of the walking intervention?

much worse		no change		much improved
-2	-1	0	+1	+2

Appendix I

IRB APPROVAL

Please note that University of Delaware IRB has taken the following action on IRBNet:

Project Title: [906901-1] Examining the impact and feasibility of a self-efficacy based walking intervention for persons with chronic non-specific neck pain.

Principal Investigator: Marisa Scibilia

Submission Type: New Project

Date Submitted: May 6, 2016

Action: APPROVED

Effective Date: June 7, 2016

Review Type: Expedited Review

Should you have any questions you may contact Nicole Farnese-McFarlane at nicolefm@udel.edu.

Thank you,

The IRBNet Support Team

www.irbnet.org