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Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory

Jayme M. Bays
University of North Dakota

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EFFECTIVENESS OF VESTIBULAR REHABILITATION USING THE DIZZINESS HANDICAP INVENTORY

by

Jayme M. Bays
Bachelor of Science in Physical Therapy
University of North Dakota, 2000

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master in Physical Therapy

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2001
This Independent Study, submitted by Jayme M. Bays in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Cindy Flom-Meland
(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)
PERMISSION

Title EFFECTIVENESS OF VESTIBULAR REHABILITATION USING THE DIZZINESS HANDICAP INVENTORY

Department Physical Therapy

Degree Master of Physical Therapy

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ABSTRACT

When individuals have an insult to the vestibular system they often experience symptoms including vertigo, decreased static and dynamic balance, and a decreased ability to participate in activities of daily living. The Dizziness Handicap Inventory (DHI) is a "dizzy-specific" questionnaire that was developed in 1990 to measure how dizziness and imbalance affect an individual’s quality of life. It is an assessment tool, made up of physical, emotional, and functional sub-scales, that has reliability and is easy to administer and score. The purpose of this study was to measure the effectiveness of a vestibular rehabilitation program, using the Dizziness Handicap Inventory, in subjects who had mixed vestibular disorders. Forty-nine randomly selected subjects participated in a telephone survey, using the Dizziness Handicap Inventory, to compare how they felt before and after their vestibular rehabilitation program. Total scores and sub-scores before and after vestibular rehabilitation were calculated and compared, using the sign test, with the alpha level set at .05. Results showed that 57.1% of the subjects interviewed had significant improvements in their total DHI scores following vestibular rehabilitation. Statistically significant differences in each of the individual sub-scores before and after vestibular rehabilitation was also found to be present (p<.001). Overall, this study demonstrates the benefits that an organized vestibular rehabilitation program can have for patients with mixed vestibular deficits, and how the Dizziness Handicap Inventory can be utilized in the assessment of outcomes.
CHAPTER I

INTRODUCTION

Eight million medical visits are made each year because of dizziness.\(^1\) Of all individuals that seek medical attention, 40-50% of all cases are caused by vestibular system disorders.\(^1\) Many individuals do not seek medical attention with the hopes that their symptoms will soon disappear. Although some vestibular deficits may spontaneously resolve in three to six months, if left untreated, chronic disability may become the ultimate outcome.\(^2\)

Acute vestibular injuries often result in persistent disequilibrium and vertigo. If intervention is not initiated patients will often show a decline in postural control, which debilitates and inhibits a patient’s ability to function independently in society. Symptoms including dizziness, nausea, and vomiting with head movements make patients become more sedentary and dependent upon others.\(^3\) Physical therapists can play a vital role in the treatment of vestibular disorders by improving balance, increasing endurance, and improving function.\(^3\) Furthermore, they provide patients with education that allows them to gain control over their symptoms and move from a passive to a more active player in the rehabilitation process.\(^4\)

Vestibular insult often results when afferent sensory input from the periphery is not converted into appropriate efferent motor output. This often results in acute vertigo, which can be attributed to altered labyrinthine function from the periphery or impaired acoustic nerve function from the central nervous system. Vertigo can further debilitate individuals by decreasing gaze stability, increasing nystagmus, which, when the head is moved, can create increased disequilibrium. Vestibular rehabilitation therapy reduces
disequilibrium and vertigo by increasing cerebellum communication to the vestibular nuclei, creating appropriate motor output in response to head movement, which is commonly known as compensation or habituation.⁴

There are three general treatment options for individuals with vestibular disorders: surgery, medication, and physical rehabilitation. Surgery generally becomes an option when an internal problem exists that cannot be treated by medication or exercise. Surgical management typically leaves a person with unpleasant side effects including increased dizziness and loss of balance, which can severely affect their overall functional abilities.⁵ Surgeries performed may include removal of acoustic neuromas, labyrinthectomies, or vestibular nerve sections.⁴

Medications that are commonly used to treat vestibular disorders include meclizine, scopolamine, and benzodiazepines. These drugs have been found to temporarily relieve the symptoms, however, when used for long periods of time, these drugs may actually inhibit recovery of vestibular function secondary to their sedative effects.⁴

Physical rehabilitation programs for the treatment of vestibular disorders have been present since the 1940s when Cawthorn⁶ and Cooksey⁷ developed head and eye movement exercises, called habituation exercises that were specifically designed to decrease vertigo and enhance vestibular system functioning. These habituation exercises would be performed in the positions that would create the most dizziness for the patient. Overall, the exercises were found to be more beneficial in improving vestibular function than general strengthening exercises alone.⁸ Today, physical therapists still use these exercises but also include exercises designed to re-train sensory and motor control and
improve gaze stabilization. Furthermore, physical therapists can work to decrease other secondary limitations that might be present by looking at general musculoskeletal function.

Problem Statement

Individuals, with vestibular deficits that do not recover spontaneously, have increased sensations of disequilibrium and poor balance. If left untreated these individuals reduce their activities, resulting in muscle weakness, decreased endurance, and limited flexibility. All of these deficits have an additive effect by limiting a person’s functional ability and overall quality of life.

Purpose of Study

The purpose of this study is to determine outcomes of patients following vestibular rehabilitation at Altru Health Institute, from 1998 to 2000, using a standardized survey, developed in 1990, called the Dizziness Handicap Inventory (DHI).

Research Questions

Three research questions were addressed for this study and included the following:

1. Do DHI total scores significantly change following vestibular rehabilitation for patients with mixed vestibular disorders?
2. Do DHI sub-scores (emotional, physical, and functional) significantly change following vestibular rehabilitation for patients with mixed vestibular disorders?
3. Do answers consistently change to specific individual questions?
Significance of Study

Vestibular rehabilitation adds to the cost of the medical care system. It is important that these costs are justified so payment from services from third party payers is guaranteed.
CHAPTER II

LITERATURE REVIEW

Anatomy of Vestibular System

The purpose of this chapter is to provide the reader with a basic understanding about the anatomy and physiology of the vestibular system. The complexity of the vestibular system and its ability to make repairs and adaptations following vestibular dysfunction is highly related to both its structure and function.

Components of Vestibular System

The vestibular system is made up of three main components. First there is a peripheral sensory component located in the inner ear, which is responsible for picking up information and relaying it to the central nervous system (CNS). Peripheral information may include head angular velocity, head linear acceleration, and head orientation. Once inside the CNS, a second component, called the central processor, will use sensory input to determine head orientation. Structures important for central processing are found in the vestibular nuclear complex and the cerebellum. Once processed there must be a motor output component available to control vision and maintain postural stability while the head is in motion. Mechanisms for motor output include the ocular muscles, the spinal cord, the vestibular ocular reflex (VOR), and the vestibulospinal reflex (VSR).\(^9\)

Peripheral Component of the Vestibular System

The peripheral component of the vestibular system is located in the inner ear. It includes the bony and membranous labyrinths and hair cells. The bony labyrinth is found in the three semicircular canals and the vestibule. The bony labyrinth is filled with
perilymphatic fluid. This fluid has a concentration that is high in potassium (K\(^+\)) and lower in sodium (Na\(^+\)), and is able to communicate with the CNS in the subarachnoid space via the cochlear aquaduct. The membranous labyrinth is located within the bony labyrinth. It surrounds the three semicircular canals, the utricle, and the saccule. It is filled with endolymphatic fluid, which is a fluid that has a higher concentration of Na\(^+\) than K\(^+\), and is noted to be similar in composition to that of intracellular fluid.\(^9\)

Hair cells are located in the ampullae and macula of the inner ear. These hair cells have afferent nerve innervation and function as sensors for head motion. The hair cells receive information related to head motion and convert it into neural firing that can be deciphered by the CNS. Each hair cell has individual processes of different sizes that project from the cell. With excitation, the motion of these projections moves toward the long process of the hair cell. Oppositely, with inhibition, motion of the processes will go away from the long process of the hair cell. Hair cells located in the ampullae and macula are both covered by membranous material, however the composition of the membranous material differs in each location making them respond to different types of head motion.\(^9\)

The ampullae hair cells project from the crista ampullaris, which is an area that is fortified with blood vessels, nerve fibers, and supporting tissue. They receive sensory information related to head movement from the semicircular canals. The hair cells of the ampullae are covered by membranous material called the cupulla. As the head moves the cupula causes endolymphatic fluid to flow in the semi-circular canals, thereby resulting in either excitation or inhibition of each hair cell. The cupula is insensitive to gravity, and
has the same density as endolymphatic fluid, making it responsive to angular head velocity.\textsuperscript{9}

The hair cells of the macula reside on the medial wall of the otolith organs (saccule/maculae) of the inner ear. The macula hair cells are covered by the otolithic membrane. The otolithic membrane differs from that of the cupula in that it contains calcium crystals called otoconia. The otoconia increases the mass of the otolithic membrane, making it have a higher density than the endolympathic fluid. This increased density of the otolithic membrane makes the macula hair cells highly sensitive to gravity and linear acceleration.\textsuperscript{9}

The semicircular canals act as rate sensors to velocity. Each semicircular canal is made up of three canals that lie perpendicular to each other. All six canals line up to become three co-planar pairs and include the right and left lateral, left anterior and right posterior, and left posterior and right anterior pairs. The co-planar pairs are in close proximity to the extraocular muscles of the eyes creating a close connection between sensory input from the canals and motor output to the eye muscles. As the head moves, the semicircular canals place a drag on the endolymphatic fluid which will be proportional to head velocity.\textsuperscript{9}

The co-planar pairs will have opposite endolymphatic fluid displacement with head movement, thus when one canal of the pair is firing, the other canal becomes inhibited. The importance of this feature is that it will create what is known as a push/pull mechanism so that if one side of the co-planar pair is damaged, the contralateral co-planar partner will continue to send head movement information to the CNS for
processing. The CNS does not have to process neural firing from both sides of the contralateral pairs, thereby decreasing sensory overload.9

The otoliths, which include the saccule and utricle, are designed to relay information to the central processor related to linear head acceleration and static tilt caused by gravity. They differ from the semicircular canals in that they respond to acceleration rather than velocity. They are able to detect acceleration by the movement of otoconia into the otolithic membrane. As acceleration increases, more otoconia will be incorporated into the otolithic membrane creating a shear force that will be detected by the hair cells. There are two otolith organs that are responsible for detection linear motion in all three dimensions.9 The saccule is arranged to pick up sensory information regarding acceleration in the occipitotcaudal and anterior-posterior axes in an upright individual. In the same upright position, the utricle will pick up sensory information regarding acceleration from interaural and anterior-posterior axes. The force of gravity makes the otolith organs highly sensitive to head when it tilts laterally, forwards, and backwards.9

The otoliths also operate using a push-pull mechanism that is similar to that of the semicircular canals to decrease sensory overload.9 Furthermore, each otolith organ membranes have a curving zone called the striola that function to separate hair depolarization within the sacculue and utricle. Hair cell vectors are directed away from the striola in the saccule and toward the striola in the utricle.10

Central Processor Component of the Vestibular System

When sensory information regarding head motion is picked up by the afferent hair cell, the information detected is sent to the central processor of the vestibular system
which is primarily located in the vestibular nuclear complex and the cerebellum. The vestibular nucleus is made up of four major parts including the superior, medial, lateral, and descending nuclei. The superior and medial nuclei are associated with the VOR. The medial nucleus is also responsible for the VSR and coordination of head and eye movements that occur together. The lateral vestibular nucleus is the most important in the activation of the VSR. The descending nucleus is connected to the cerebellum and the superior, medial, and lateral nuclei. The vestibular nucleus processes all afferent sensory information and sends it as efferent information to allow for motor output.\(^9\)

The cerebellum functions to regulate and process input from the otolith organs. Furthermore the cerebellum is active in the processing and regulation of the VOR gain and duration, as well as the VSR for the maintenance of normal posture and stability. The cerebellum will not produce the VOR and VSR, but will be key in adjusting these reflexes to create appropriate motor output.\(^9\)

Motor Output Component of the Vestibular System

The motor output for the VOR are the neurons of the ocular motor nuclei, which are responsible for the innervation of the extraocular muscles. The extraocular muscles are arranged in pairs and lie in orientations that are similar to that of the semicircular canal pairs. This allows for movement of the eyes in the same plane as the movement of the head.\(^9\) The VOR functions to maintain binocular fixation and stable foveal images. It allows for eye movement that is in equal in magnitude and opposite in direction to head movement, allowing constant eye orientation in space.\(^10\) This phenomenon becomes very important when participating in activities such as walking and running. During ambulation the head will randomly move in an unpredicted motion. The VOR works to
maintain gaze stability while walking. Without gaze stability there would be an increase in blurriness from random head movements, which would ultimately lead to postural instability.\textsuperscript{11}

The VSRs are a complicated set of reflexes that are primarily responsible for taking head movement, and head movement relative to gravity, and activating the antigravity musculature, which includes the extensors of the neck, trunk, and extremities. It functions to stabilize the head and body. This reflex is distributed from the vestibular nucleus to the spinal cord through three primary pathways, which include the lateral vestibulospinal tract, the medial vestibulospinal tract, and the reticulospinal tract. The lateral vestibulospinal tract is primarily responsible for the activation of the lower extremity musculature that corresponds to head movement by adjusting postural reflexes. The medial vestibulospinal tract has pathways that lead to the neck musculature and the extraocular nuclei for the organization of head and eye movement, which play a key role in the maintenance of gaze stabilization. Finally the reticulospinal tract, which is a highly random pathway, is key in adjusting postures and motor output according to various sensory input.\textsuperscript{9}

**Examination of Dizzy Patients**

Evaluating dizzy patients requires a thorough history collection. Important issues to address include past medical history, medication use, and toxin exposure. Furthermore, home situation and support systems will also be key in the evaluation process. When a patient complains of dizziness, it will be important to determine the character, severity, duration, precipitating factors, and associated symptoms that may accompany the dizziness.\textsuperscript{12}
When a patient has complaints of dizziness it is imperative that the patient receive a thorough examination of the peripheral vestibular, vascular, and neurological systems. When patients are referred to physical therapists to be examined for dizziness, the therapist must be competent in evaluating these three systems.\(^{12}\)

A peripheral exam often involves trying to induce a nystagmus in any patient with a suspected vestibular disorder. Nystagmus is defined as the rhythmic oscillation of the eyes. The oscillation is fast in one direction and slow in the opposite direction. The nystagmus is named after the direction of the fast oscillation. Normally, the eyes will move in a horizontal plane together, but a nystagmus will cause the movement of an eye in almost any direction. Nystagmus may be caused by a peripheral or central lesion, and is often accompanied with a spinning sensation experienced by a patient, commonly called vertigo.\(^{13}\)

A nystagmus will commonly have a horizontal, rotary, or vertical characteristics. A peripheral pathology may be evident if the nystagmus shows horizontal or rotary characteristics. Central pathology is usually definite if the nystagmus has vertical characteristics, however central pathology may exhibit both horizontal and rotary characteristics. There are a variety of ways of inducing a nystagmus with patients during an evaluation, which includes the use of Frenzel glasses, gaze testing, and Hallpike testing.\(^{12}\)

Frenzel glasses are high diopeter lenses in a frame with a light source. The glasses are worn by patients and operate by preventing visual fixation. Frenzel lenses will ultimately induce a nystagmus in patients with peripheral vestibular disorders.\(^{12}\)
Gaze testing involves a patient following an examiner's finger across the visual field without deviating more than 40-45 degrees from mid-position. Patients with peripheral or central lesions will develop a nystagmus during gaze testing.\textsuperscript{12}

Hallpike testing is used to diagnose benign paroxysmal positional vertigo (BPPV). BPPV is most commonly caused by abnormal excitation of one or more of the semicircular canals. "It is the most common cause of vertigo in patients with peripheral vestibular dysfunction and accounts for 20\% to 30\% of all patients seen for vertigo."\textsuperscript{11(p608)} Its symptoms include, brief, but intense episodes of vertigo and disequilibrium with sudden head movements. If left untreated, BPPV can lead to disequilibrium, unsteady gait, sensitivity to head movement and linear acceleration, falls, and the inability to maintain balance using vestibular cues.\textsuperscript{11} BPPV generally affects one ear, and when the Hallpike maneuver is performed on the affected ear, the patient will experience symptoms including increased dizziness, nystagmus, and possibly nausea and vomiting.\textsuperscript{12}

If a nystagmus cannot be generated in a patient then the evaluation should focus on a thorough otologic examination of the ear by a professional. This will rule out any problems that may occur with the ear, such as acute otitis media, cholesteatoma or an inner ear fistula, which is beyond the scope of this literature review.\textsuperscript{12}

The vascular system overview should also be a part of the evaluation of the dizzy patient, as dizziness may also be indicative of cardiac disease. The examination should involve checking positional blood pressures along with examination and auscultation of the head and neck.\textsuperscript{12}
A thorough evaluation of the nervous system must be performed in the examination of the dizzy patient and will include cranial nerve testing, cerebellum function, the VSR, and proprioception testing. Cranial nerves should be tested for visual acuity and control of the ocular muscles. Cerebellum function is assessed for signs of ataxia, decreased motor control, and intention tremors. The VSR can be examined by having the patient perform special tests including the Rhomberg, sharpened Rhomberg, and tandem gait and standing tests. Proprioception of the lower extremities involves examining the patient’s ability to determine joint position in space.\(^\text{12}\)

Other important features in the evaluation of the dizzy patient will include looking at other lab exams including and electrocardiogram (ECG), magnetic resonance imaging (MRI), and computer tomography (CT) scans. Diseases such as Meniere’s disease, labyrinthitis, perilymph fistula, and ototoxicity should also be ruled out.\(^\text{12}\)

Vestibulometric testing results including posturography, electronystagmography, and rotational chair testing should be examined. Posturography tests will provide information about the balance system and the VSR that cannot be determined visually. It will determine the degree of postural sway under various conditions. It will also determine the patient’s ability to use the somatosensory, visual, and vestibular systems together and individually. Electronystagmography and rotational chair testing both provide information about the functioning of the vestibulo-ocular system. All three of these vestibular tests are valued in determining whether the vestibular deficit is peripherally or centrally located. It also allows for the assessment of sensory input and will provide information on physiologic and functional vestibular compensation.\(^\text{4}\)
Effectiveness of Vestibular Rehabilitation

The use of vestibular rehabilitation is appropriate when there is vestibular deficit that is stable and not progressive. Patient outcomes for individuals participating in vestibular rehabilitation programs have been found to be diagnosis specific. Individuals with BPPV and peripheral lesions seem to benefit the most from vestibular rehabilitation programs, while individuals with bilateral peripheral lesions and CNS lesions have had limited success rates.4

Following the age of 70, an individual will lose an average of 20-40% of his/her hair cells. This deterioration of the peripheral component of the vestibular system generally results in changes in the visual and proprioceptive systems. Furthermore deterioration of the peripheral vestibular system will often result in poor balance and ataxia. After the age of 70, 50% of all elderly individuals will experience imbalance.12 Vestibular rehabilitation exercises seem to help this population by increasing postural control and improving overall condition. Physical therapists can also help this population with various psychosocial aspects and by providing patients with assistive devices if needed.4

The primary role of the therapist is to provide patients with education about vestibular diseases and rationale as to how a vestibular rehabilitation program might be beneficial. Vestibular rehabilitation may include providing a patient with rapid head movement exercises to improve gaze stability, static and dynamic balancing exercises, coordination exercises, as well as, analysis of gait. Therapists also play a vital role in teaching patients how to maintain gains from a vestibular rehabilitation program.4
Many times otolaryngologists will provide patients with vestibular exercises to be performed at home. Unfortunately, many patients do not perform these exercises at home because they dislike the symptoms of vertigo that these exercises produce, have no understanding as to how these exercises improve function, or they just do not like to exercise. Some patients do not want to take the time to read written instructions or they fail to understand the written instructions that are provided.\textsuperscript{14}

A study by Cohen\textsuperscript{14} was designed to determine if individualized treatment programs that included purposeful and interesting activities, in a physical therapy setting, improved function more than a generalized home exercise program. Activities of daily living (ADL) testing revealed that patients who participated in therapy that was purposeful showed greater improvement in ambulation and home management tasks than patients who were only provided with a home exercise program \((p < 0.03)\).\textsuperscript{14}

This study demonstrated that subjects who received therapy that included activities that were purposeful to each individual resulted in greater functional improvements than a home exercise program alone. Physical therapists are trained to individualize therapy with each patient. Furthermore, they are able to assess outcomes, make changes to programs as needed, and provide patients with support during treatment.\textsuperscript{14} This justifies the important role that physical therapists can have in the treatment of patients with vestibular deficits.

Vestibular rehabilitation in a clinical setting results in increased costs for health care. Justification of its effectiveness must be made for third party payer reimbursement. Shepard and colleagues\textsuperscript{4} conducted a study to determine if a customized vestibular rehabilitation program provided in a clinical setting was more effective than a generic
vestibular rehabilitation home program. Statistics revealed that only 50% of the subjects in the generic group had complete recovery, or minimal disability, while 75% in the customized group had similar results. Those in the customized group demonstrated reduction in nystagmus and motion sensitivity, and exhibited improvements in static and dynamic balance. The generic group only demonstrated improvements in static balance. Both groups had a reduction in dizziness while doing their exercises, but only the customized group showed a reduction in dizziness during routine daily activities. Overall this study concluded that individuals benefit from customized vestibular rehabilitation, making it justifiable to third party payers.

A study conducted by Cohen was designed to determine if balance retraining and vestibular habituation exercises improved a patient’s ability to perform ADLs. The study included 16 adults between the ages of 35-82 years old who received physical therapy over a two-year period. The patients had a variety of vestibular diagnoses and received approximately 2-12 treatment sessions. Subjects completed a self-assessment of their ability to perform various ADLs before physical therapy (Pre-PT) and after physical therapy (Post-PT). Pre-PT results showed that 94% of the patients had difficulty standing up from a chair, 81% had problems ambulating on all surface types, and 75% had difficulty showering and bathing. Non-parametric analysis of variance revealed that significant differences among levels of ADL skills existed when comparing Pre-PT, Post-PT, and normative scores. Pre-PT scores were significantly worse than normative scores \((p<0.0001)\). Post-PT scores were significantly better than Pre-PT scores \((p<0.0001)\), but significantly worse than normative ADL scores. This study demonstrated that although
some residual deficits remained, patients showed improvements in ADL performance following vestibular rehabilitation.\(^3\)

A study by Horak and colleagues\(^2\) was designed to determine if a vestibular rehabilitation program could be developed that would address dizziness and balance problems. If such a program was developed, the researchers wanted to determine if it would be more effective than a general exercise program and medications. Twenty-five subjects between the ages of 18-60 years old participated in this study. All subjects had complaints of dizziness and imbalance for at least six months, and also had abnormal posturography scores. Subjects were randomly selected to receive vestibular rehabilitation, general conditioning, or vestibular suppressant medications for six weeks. Results indicated that the vestibular rehabilitation subjects had significantly better posturography tests \((p<0.01)\) and improved standing times on one foot with eyes open and with eyes closed. Dizziness decreased in all three groups but decreased significantly in the vestibular rehabilitation and vestibular medication groups \((p<0.01)\). This preliminary study demonstrated that an organized vestibular rehabilitation program was beneficial in decreasing dizziness and improving balance, while the other two forms of treatments were only successful in decreasing complaints of dizziness\(^2\).

**Dizziness Handicap Inventory**

In 1990, Jacobson and Newman\(^15\) developed the DHI, "which was a disease-specific questionnaire, developed for individuals with dizziness or balance problems and measures how vertigo and imbalance affect an individual’s quality of life.\(^1\)(p891) The DHI is a 25-question survey that has a total score of 100 points and is made up of physical, functional, and emotional questions. The physical sub-scale of the survey is worth 28
points and the emotional and functional sub-scales are both worth 36 points for a total of 100 points. Each question has three possible responses, which include “yes,” worth four points, “sometimes,” worth two points, and “no,” worth zero points. Percentages for total and sub-scores describe the amount of disability each patient reports, meaning the higher the percentage, the greater amount of disability that is perceived by the patient. See Appendix B for the DHI survey.

The inventory started out as a 37-question inventory that was split up into three categories, which included 16 functional, 11 emotional, and 11 physical questions related to dizziness. The inventory prototype was given to 63 patients before vestibulometric testing. Statistical analysis showed the DHI to have a reliability of 0.90 for total scores and 0.74–0.84 for each sub-scale. Jacobson and Newman removed 12 questions that had poor correlation scores, making the inventory the 25-question inventory that is used today. The DHI was given to 106 patients who had variable amounts of dizziness before vestibulometric testing. Patients were divided into groups that included patients that had occasional, frequent, and continuous dizziness. The removal of the 12 questions did little to change the reliability of the DHI giving it a total correlation of 0.89 for the total score and 0.78–0.85 for the sub-scores. Analysis of variance revealed that there was a significant difference in DHI scores among the varying levels of dizziness. Overall, those who had a greater amount of dizziness showed higher DHI scores. Jacobson and Newman tested the test:retest reliability of the 25-question DHI by administering the inventory to 14 subjects. Results, using Pearson’s Product moment correlation for total and sub-scores, revealed that the DHI had excellent test:retest
reliability with a total score correlation of 0.97. The sub-scores also showed excellent test-retest reliability with the functional, emotional, and physical portions having correlation values of 0.94, 0.97, and 0.92 respectively. Overall, Jacobson and Newman concluded that the DHI was reliable, easy to administer, easy to score and interpret, and was useful in the assessment and planning of the dizzy patient.

Today, vestibular rehabilitation programs test their effectiveness by using the DHI. In 1998, Cowand colleagues conducted an investigation to determine if vestibular rehabilitation created significant changes following one year of treatment. Thirty-seven patients with the diagnosis of central, peripheral, or mixed vestibular lesions were referred to physical therapy 1-2 times a week to participate in a vestibular rehabilitation program. Each patient completed a DHI before the initiation of physical therapy, and following discharge from physical therapy. Treatment time ranged from 2-38 weeks, and consisted of vestibular exercises including the following: gaze-stabilization exercises, vestibular stimulation, balance and proprioception retraining, general strengthening, and safety exercises. Upon discharge all patients were provided with a home exercise program. Results indicated that 29 patients showed improvements following physical therapy, while three showed no change, and five patients worsened. Thirty-five percent of the patients had DHI scores that improved by more than 18 points. A post hoc test revealed that differences in diagnostic categories existed. Patients with peripheral lesions showed the greatest improvement in the emotional portion of the DHI than those patients with the other two diagnoses. Furthermore, patients with peripheral lesions also had better functional scores than those patients with mixed lesions. It is worth noting that all patients were taking medications for their specific diagnosis,
therefore the authors of this study believed that patients treated with a combination of exercise and medical management had better outcomes than medical management or exercise alone. Overall, this study demonstrated that the DHI was easy to administer and was a useful tool in the assessment of vestibular function.8

Physical therapists see patients with a variety of diagnoses. Many may find it easier to use one generic survey for all patients, rather than using a disease-specific survey form such as the DHI. One generic form commonly used by clinicians is the 36-item short form survey (SF-36). The SF-36 provides the therapist with a global measure of health status and can be used with all patients regardless of their diagnosis.1

In 1997, Enloe and Sheilds1 conducted a study to determine if a relationship existed between the DHI and SF-36. They also wanted to estimate the reliability and responsiveness of the DHI and SF-36 in patients with a variety of vestibular disorders. Finally, they wanted to determine how SF-36 scores, provided from patients with vestibular disease, compared with scores from the general population.1

Overall, each survey had high reliability coefficients that ranged from 0.64-0.95. When each survey was compared to one another, the correlation was poor to moderate with correlation coefficients ranging from 0.11-0.71. Patients completed both surveys following a 6-8 week vestibular rehabilitation program. Results indicated that patients had improvements in total DHI scores by 11.94%, while they had improvements in the mental and physical components of the SF-36 by 6.67% and 4.35% respectively. When compared to the general public, SF-36 scores were worse for the patients with vestibular diagnoses. Following 6-8 weeks of vestibular rehabilitation, SF-36 scores showed improvements, making the scores closer to that of the general public. These results make
both the SF-36 and DHI useful in determining the health status of patients with vestibular
dysfunction. Although both surveys are equally useful in determining outcomes,
patients may be more satisfied with an 11.94% improvement rather than a 6.67%
improvement. It is also worth noting that the DHI is easy to administer and score,
providing a physical therapist with immediate results, thus, enhancing a physical
therapist's time management in a clinical setting.
CHAPTER III

METHODOLOGY

Subjects

Ninety-five adults who received outpatient vestibular rehabilitation in physical therapy between 1998 and 2000, by Maureen Landsberger MPT, at Altru Health Institute in Grand Forks, North Dakota, were contacted by telephone and asked to complete the Dizziness Handicap Inventory questionnaire. Forty-nine patients agreed to participate in the study. The participants’ mean age was 60.6 years, ranging from 18-90 years.

Instrumentation

The DHI questionnaire was developed by Dr. GP Jacobson and Dr. CW Newman in 1990, and consists of questions that are related to dizziness and balance problems. Nine questions of the DHI are related to the emotional and functional sub-scales, and seven are related to the physical sub-scale. The DHI has a total of 100 points possible with 28 points coming from the physical sub-scale and 36 points from the emotional and functional sub-scales. Higher scores are associated with increased dizziness or unsteadiness.

Procedure

The purpose of the study was explained to each subject followed by an invitation to participate and a guarantee for patient confidentiality. Subjects were asked to answer each question on the DHI. They provided responses for how they felt before physical therapy intervention (Pre-PT) and how they felt at the time of the telephone conversation (Post-PT) for each of the 25 dizzy-specific questions. Subjects were told to answer each question with a response of yes (4 points), sometimes (2 points), or no (0 points).
All participants were informed that they could discontinue the phone interview at anytime if they wished. All telephone surveys were conducted by two University of North Dakota physical therapy graduate students. A copy of the phone interview and the DHI questionnaire can be found in appendix B.

Data Analysis

Total scores, percent total scores, sub-scores, percent sub-scores, and change in scores were calculated for each subject using the computer statistical program SPSS.\textsuperscript{16} The Wilcoxin two sample test and sign test, which are non-parametric statistical tests, were used to analyze if differences existed in total scores (Pre-PT & Post-PT), sub-scores (Pre-PT & Post-PT), and each individual question (Pre-PT & Post-PT) utilizing a .05 $\alpha$ level.\textsuperscript{17} The independent variable consisted of each subject and each individual question, whereas the dependent variable consisted of the total and sub-scores.
The Wilcoxin two sample test was not reported due to multiple tie results. A significant difference was identified by the sign test between Pre-PT and Post-PT total DHI scores (p<.001). Fifty-seven percent (28/49) of the subjects had improvements in total DHI scores of greater than 18 points (see Figure 1). Each of the individual sub-scores was found to have significant Pre-PT and Post-PT differences (p<.001). See Table 1 for DHI outcomes.

Figure 1. Percentage of subjects with score changes deviating from 18 points. Points greater than 18 show significant improvement in DHI scores following PT intervention.
Table 1. DHI Outcomes. DHI score changes, z-scores and probabilities of the 49 subjects following physical therapy intervention.

<table>
<thead>
<tr>
<th></th>
<th>PHYSICAL</th>
<th>EMOTIONAL</th>
<th>FUNCTIONAL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved&lt;sup&gt;a&lt;/sup&gt;</td>
<td>42</td>
<td>34</td>
<td>41</td>
<td>43</td>
</tr>
<tr>
<td>Decrease&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>No Change&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7</td>
<td>13</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>n</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>z-score</td>
<td>-6.326</td>
<td>-5.167</td>
<td>-6.247</td>
<td>-5.963</td>
</tr>
<tr>
<td>p</td>
<td>&lt; 0.001&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt; 0.001&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt; 0.001&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt; 0.001&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- a. Score after treatment lower than score before treatment
- b. Score before treatment lower than score after treatment
- c. No change in score
- d. Significant difference

Two out of the 25 DHI questions did not demonstrate a significant difference in Pre-PT and Post-PT scores. Question 20 (p=.250) and Question 22 (p=.063) of the DHI questionnaire did not demonstrate a significant difference in Pre-PT and Post-PT answers. See Appendix C for specific DHI questions and outcomes to each question following physical therapy intervention.
CHAPTER V

DISCUSSION & CONCLUSION

When comparing Pre-PT and Post-PT results using the DHI, literature explains that an 18-point improvement is considered significant. No literature has been published that discusses what values are considered significant for sub-score point totals. Future studies may want to consider determining how much of a change in sub-score points is considered significant. Our results demonstrated that 57.1% of the subjects surveyed had significant improvements in their total DHI scores. Overall, 43 subjects had improved DHI scores, four subjects had no change in scores, and two subjects had scores that had worsened.

Questions 20 and 22, both of which are questions related to the emotional sub-score, showed no significant differences between Pre-PT and Post-PT answers provided by the subjects surveyed. Question 20 asked patients if they were afraid to stay home alone, while question 22 asked if the patients’ dizziness placed stress on relationships with family and friends. Significance may not have existed because patients might have found these questions to be too personal to discuss over the phone with the interviewers.

One interesting thing to note is that two subjects had lower scores in the emotional category of the DHI. Although their functional and physical problems might have remained the same, persistent dizziness may have become emotionally wearing as time went on. When physical therapy intervention cannot improve patients’ physical and functional well being, emotional problems may begin to surface. It might benefit patients’ quality of life if the physical therapist refer such individuals to trained professionals, such as psychologists and counselors, who can treat these patients for
issues such as stress, anxiety, and depression that might be resulting from a vestibular disorder.

The subjects in this study were chosen from one facility, rather than a collection of facilities. Although this facility may have been representative of rural communities, it may not have been representative of the general population. More studies should be conducted investigating the effects of vestibular rehabilitation outcomes between rural and urban facilities to see if differences might exist.

Age is another factor that might have played a major role in the results of this study. The subjects chosen to participate had ages that ranged from 18-90. This high variability in age might have had effects on outcomes following vestibular rehabilitation. As individuals go through the natural aging process somatosensory, visual, and proprioceptive systems naturally decline resulting in inappropriate movement strategy selection. Aging combined with co-existing medical conditions such as cardiac and pulmonary disease might further reduce the effectiveness that a vestibular rehabilitation program might have for the elderly population.

Another unknown issue that might have affected the outcomes of this study included medications that the patients might have been prescribed. The subjects that participated in this study were not asked to report medications that they were taking during the phone survey. It would be beneficial to ask subjects in future studies what type of prescription and over-the-counter medications that they might be taking so that side effects from those medications can be accounted for.

Patients that participated in this study were treated for BPPV and mixed vestibular dysfunctions. One limitation of this study is that all subjects were compared to
each other rather than separated by diagnoses. Previous literature has shown that patients who have been treated for BPPV and unilateral peripheral lesions tend to have better outcomes with vestibular rehabilitation than patients being treated for mixed vestibular dysfunctions\(^4\). Therefore, future studies might want to consider separating the two diagnoses when determining outcomes.

It should also be noted that female and male subject outcomes were not compared in the study. It would be interesting to determine if gender differences exist in total scores as well as the physical, functional, and emotional sub-scores of the DHI.

All of subjects that participated in this study had received physical therapy from 1998 to 2000. When the phone surveys were conducted, some of the participants may have had some time that had lapsed since their last physical therapy session. The length of time between individual patient discharge dates and dates of the survey may have made it difficult for the subjects to recall how they felt before and after physical therapy. Improvements that were made might have been a result of time alone, which were not accounted for during the study and should be considered when conducting future studies.

Conclusion

Overall, this paper should provide a reader with a general understanding of the anatomy and physiology, research, evaluation, and assessment of the vestibular system. The anatomy and physiology of the vestibular system is very complex and includes a peripheral input, central processing, and a motor output component. If any component of the vestibular system is altered, a patient's functional status will be altered.

Research shows that patients with stable vestibular deficits can improve functionally with supervised vestibular rehabilitation programs. All though not all
diagnoses will have complete recovery, improvements can be made that can positively impact a patient’s quality of life.

A physical therapy evaluation of patients that complain of dizziness should be performed by a trained physical therapist, and should include a thorough history, systems, and laboratory data review. When a patient is provided with a vestibular rehabilitation program it is important for the physical therapist to individualize therapy, as not all cases will be the same.

Finally, the assessment of outcomes is crucial in determining if vestibular rehabilitation enhances a patient’s quality of life. Furthermore, outcomes are crucial in justifying the importance of vestibular rehabilitation to third party payers. One way to measure outcomes is to use patient surveys. The DHI is a “dizzy-specific” 25-question survey that is easy to administer and score, and provides a therapist with a patient’s perceived emotional, physical, and functional status. It is a tool that has reliability, and is useful in the assessment and planning of physical therapy.

This study shows the benefits of vestibular rehabilitation using the DHI as an assessment of outcomes for rural communities. Future studies should be conducted that compare rural versus urban community outcomes, differential diagnoses, age, time, medication, and gender differences to determine if significant outcomes exist following vestibular rehabilitation.
APPENDIX A
The purpose of this study is to investigate patient outcomes after participating in a physical therapy vestibular rehabilitation program.

Former Altru physical therapy vestibular rehabilitation outpatients will be contacted by phone and asked to answer questions to the Dizziness Handicapped Inventory (DHI). The DHI is a standardized dizzy-specific, questionnaire used to quantify the impact of dizziness on quality of life. It aims at measuring emotional, physical, and functional capabilities in individuals and is commonly used to measure changes after clinical intervention. Answers to each question will be scored and evaluated to determine the effectiveness of vestibular rehabilitation. Results from this survey will further improve vestibular physical therapy evaluation and treatment options resulting in improved patient quality of life.
PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary. Attach any surveys, tests, questionnaires, interview questions, examples of interview questions (if qualitative research), etc., the subjects will be asked to complete.)

Subjects: Subjects will consist of outpatients treated for vestibular dysfunction at Altru Health Institute by Marreen Landsberger MPT from 1998 to the present.

Survey: The survey will consist of the DHI questionnaire developed by Dr. GP Jacobson and Dr. CW Newman in 1990. It consists of questions are related to dizziness and balance problems. These questions should not be surprising to the subjects for many of the questions were part of the routine physical therapy vestibular evaluation. This survey will be conducted by phone and will be completely voluntary.

Procedures: A list of former vestibular rehabilitation outpatient names and phone numbers will be collected. Each subject will be contacted by phone and asked to participate in this study. The names and phone numbers of each subject will be kept confidential and will be destroyed immediately following collection of the data. The survey will be completely voluntary and each subject will have the right to refuse to participate if desired. The completed surveys will be kept in a locked file in the University of North Dakota department of Physical Therapy for 3 years, whereby they will then be destroyed. A copy of the survey is included at the end of this form.

Data Analysis: The investigators will examine the compiled responses from the surveys. The use of traditional descriptive and analytical statistics, with the use of the computer program SPSS, will be used to determine the results. A set alpha level of 0.05 will be used for all statistical analysis.

Data Reported: All results from this study will be reported to Altru Health Institute and the University of North Dakota Department of Physical Therapy. Results will also be available for the public to view.

References for Survey:
http://www.cscd.nwu.edu/public/balance/dizzy.cfm


3. BENEFITS: (Describe the benefits to the individual or society.)
benefits: The DHI has been shown to be highly reliable, and results from this questionnaire will benefit the practice of physical therapy by improving the evaluation and treatment process. By using the DHI, physical therapy treatments and goals will be more focused and measurable according to patient perceived problems. This will ultimately result in improved patient satisfaction, functional outcomes, and enhanced quality of life.

4. RISKS: (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to protect the confidentiality of data obtained, debriefing procedures, storage of data, how long data will be stored (must be a minimum of three years), final disposition of data, etc.)

Risks: There are minimal risks involved in this study. Some of the questions asked on the DHI might result in embarrassment for the subjects. However, most of the questions should be familiar from their initial physical therapy evaluation and should not be surprising. Participation is voluntary and all surveys will remain anonymous and confidential. The names and phone numbers of the subjects will be kept confidential and will be destroyed immediately following the collection of the data. All surveys will be kept in a locked file in the University of North Dakota Department of Physical Therapy for 3 years, whereby they will then be destroyed.
3. CONSENT FORM: Attach a copy of the CONSENT FORM to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no CONSENT FORM is to be used, document the procedures to be used to assure that infringement upon the subject’s rights will not occur.

Describe where signed consent forms will be kept and for how long (must be a minimum of 3 years), including plans for final disposition or destruction.

Consent Form: There will not be a formal consent form used for this study. Each participant will receive a phone call explaining the purpose of the study. Oral completion of the DHI questionnaire will be regarded as the subject’s informed consent. The surveys will be kept for three years and then destroyed.

6. For FULL IRB REVIEW forward a signed original and fifteen (15) copies of this completed form, including fifteen (15) copies of the proposed consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to the address below. An original and 19 copies are required for clinical medical projects. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical: 7 copies if the proposal is clinical medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company’s protocol must be provided.

Office of Research & Program Development
University of North Dakota
Grand Forks, North Dakota 58202-7134

On campus, mail to: Office of Research & Program Development, Box 7134, or drop it off at Room 105 Twamley Hall.

For EXEMPT or EXPEDITED REVIEW forward a signed original, including a copy of the consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to one of the addresses above. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University’s policies and procedures governing the use of human subjects.

SIGNATURES:

[Signatures]

Principal Investigator

4-19-00

Date

Project Director or Student Adviser

4-19-00

Date

Training or Center Grant Director

Date

(Revised 2/2000)
STUDENT RESEARCHERS: As of June 4, 1997 (based on the recommendation of UND Legal Counsel) the University of North Dakota IRB is unable to approve your project unless the following "Student Consent to Release of Educational Record" is signed and included with your "Human Subjects Review Form."

STUDENT CONSENT TO RELEASE OF EDUCATIONAL RECORD

Pursuant to the Family Educational Rights and Privacy Act of 1974, I hereby consent to the Institutional Review Board's access to those portions of my educational record which involve research that I wish to conduct under the Board's auspices. I understand that the Board may need to review my study data based on a question from a participant or under a random audit. The study to which this release pertains is 

The effects of vestibular rehabilitation using the dizziness handicap inventory

I understand that such information concerning my educational record will not be released except on the condition that the Institutional Review Board will not permit any other party to have access to such information without my written consent. I also understand that this policy will be explained to those persons requesting any educational information and that this release will be kept with the study documentation.

Date: 4-19-00
Signature of Student Researcher

1 Consent required by 20 U.S.C. 1232g.
Institutional Review Board  
Research Project Action Report  

Date: May 31, 2000  
IRB #: PT-014  

Principal Investigator: Jayme Bays & Nicholl Dinius  
Department: Physical Therapy-UND  
Phone #: 777-9782  

Address to which notice of approval should be sent: #3717 Berkeley Dr., Grand Forks ND 58203  

Research Coordinator: Same as above  
Phone #: 777-9782  

Project Title: Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory  

The above referenced project protocol and informed consent was reviewed by the Altru Health System Institutional Review Board on and the following action was taken:  

☐ Project approved. Next Scheduled review is on  
If no date is given, then review will be required in 12 months. (See REMARKS SECTION for any special condition.)  

☐ Project approved. EXPEDITED REVIEW NO.  
Next scheduled review is on  

☐ Project approved. EXEMPT CATEGORY NO.  
No periodic review scheduled unless so stated in REMARKS SECTION.  

☐ Project approval deferred. (See REMARKS SECTION for further information.)  

☐ Project denied. (See REMARKS SECTION for further information.)  

☐ Amendment approved  
☐ Administrative change approved  
☐ Protocol revision approved  
☐ Revised consent form approved  
☐ Adverse event reviewed - Date of event  
☐ Other  

REMARKS:  
Any changes in protocol, adverse occurrences or deaths in the course of the research project must be reported immediately to the IRB chairperson or the IRB office (780-6161).  

Signature of Chairperson or Designated IRB Member  
Altru Health System Institutional Review Board  

Date  

If the proposed project is to be part of a research activity funded by a federal agency, a special assurance statement or a completed 596 Form may be required. Contact IRB office to obtain the required documents.
I have reviewed the proposal received from Jayme M. Bays and Nicholl Jurgens-Dinius Department of Physical Therapy (College of Medicine University of North Dakota) entitled "Effects of Vestibular Rehabilitation Using the Dizziness Handicap Inventory" and recommend that the Altru Health System Institutional Review Board be the lead IRB because subjects will be accrued at their institution.

Warren C. Jensen, Chair
University of North Dakota Institutional Review Board
4/26/00

Kevin J. Tveter, M.D., Chair
Altru Health Systems Institutional Review Board
5/7/00
VESTIBULAR REHAB OUTCOME SURVEY

The vestibular system is housed in the inner ear. It works in conjunction with your visual and sensory systems to control your balance and orientation to space.

The Altru Health Institute has a vestibular rehabilitation program that evaluates and treats patients with vestibular dysfunctions. The physical therapist that treats these patients is Maureen Landsberger, MPT. She can be contacted at 780-2315. Steve Rood, MPT, Physical Therapy Director can also be reached at this number.

Altru will be working with graduate physical therapy students from the University of North Dakota to conduct a vestibular rehab research project. The project is designed to interpret outcomes of vestibular rehab. Patients will be contacted via phone and asked a series of questions related to balance and dizziness. Patients will be assured of the confidentiality of their identity and the answers given.

Questions regarding the study can be addressed by the UND students involved (UND 777-2831) or the above mentioned clinicians.

Maureen Landsberger, MPT

Steve Rood, MPT
Director of Physical Therapy
Altru Health System
APPENDIX B
Phone Interview

Introduction:
Hello, this is Nicholl Jurgens/Jayme Bays, and I am a physical therapy student at the University of North Dakota. I am currently conducting a study for Maureen Landsberger. She is a physical therapist at Altru Health Institute in Grand Forks. The purpose of this study is to look at patient outcomes following physical therapy. I understand that you were a patient of Maureen’s, and I was wondering if you would be interested in taking a few minutes to answer some questions related to our study on vestibular rehabilitation. (Wait for a response)

The questions I am going to ask you come from a standardized questionnaire called the Dizziness Handicap Inventory. It is a series of 25 questions based on symptoms associated with dizziness. Your participation in this study will remain confidential, and you may discontinue at anytime if you do not wish to continue answering the questions. Is it alright for me to continue?

With each question asked, I would like you to answer with either yes, no, or sometimes for both how you felt before and after therapy. (Ask the 25 questions)

Closing:
OK, I would like to sincerely thank you for taking time to participate in this study. The results of this study will be made available to the public upon completion. Again thank you for your time.
<table>
<thead>
<tr>
<th>Dizziness Handicap Inventory Questions</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does looking up increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>2. Because of your problem, do you feel frustrated?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>3. Because of your problem, do you restrict your travel for business or recreation?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>4. Does walking down the aisle of a supermarket increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>5. Because of your problem, do you have difficulty getting into or out of bed?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing or to parties?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>7. Because of your problem, do you have difficulty reading?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>8. Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>9. Because of your problem, are you afraid to leave your home without having someone accompany you?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>10. Because of your problem, have you been Embarrassed front of others?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>11. Do quick movements of your head increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>12. Because of your problem, are you afraid of heights?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>13. Does turning over in bed increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>14. Because of your problem, is it difficult for you to do strenuous housework or yardwork?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>15. Because of your problem, are you afraid people may think you are intoxicated?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>16. Because of your problem, is it difficult for you to walk by yourself?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>17. Does walking down a sidewalk increase your problem?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>18. Because of your problem, is it difficult for you to Concentrate?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>19. Because of your problem, is it difficult for you to walk around your house in the dark?</td>
<td>Yes  Sometimes  No</td>
<td>Yes  Sometimes  No</td>
</tr>
<tr>
<td>Dizziness Handicap Inventory Questions</td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>20. Because of your problem, are you afraid to stay home alone?</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
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<td></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>21. Because of your problem, do you feel handicapped?</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
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<td></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>22. Has your problem placed stress on your relationships with members of your family or friends?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>23. Because of your problem, are you depressed?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
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<td></td>
<td>No</td>
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</tr>
<tr>
<td>24. Does your problem interfere with your job or household responsibilities?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>25. Does bending over increase your problem?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
APPENDIX C
# Dizziness Handicap Inventory Questionnaire and Outcomes Following Physical Therapy

<table>
<thead>
<tr>
<th>Dizziness Handicap Inventory Questions</th>
<th>Improved</th>
<th>Decreased</th>
<th>No Change</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does looking up increase your problem?</td>
<td>26</td>
<td>0</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>2. Because of your problem, do you feel frustrated?</td>
<td>27</td>
<td>1</td>
<td>21</td>
<td>49</td>
</tr>
<tr>
<td>3. Because of your problem, do you restrict your travel For business or recreation?</td>
<td>15</td>
<td>0</td>
<td>34</td>
<td>49</td>
</tr>
<tr>
<td>4. Does walking down the aisle of a supermarket Increase your problem?</td>
<td>17</td>
<td>0</td>
<td>32</td>
<td>49</td>
</tr>
<tr>
<td>5. Because of your problem, do you have difficulty Getting into or out of bed?</td>
<td>30</td>
<td>0</td>
<td>19</td>
<td>49</td>
</tr>
<tr>
<td>6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing or to parties?</td>
<td>17</td>
<td>0</td>
<td>32</td>
<td>49</td>
</tr>
<tr>
<td>7. Because of your problem, do you have difficulty reading?</td>
<td>10</td>
<td>0</td>
<td>39</td>
<td>49</td>
</tr>
<tr>
<td>8. Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?</td>
<td>27</td>
<td>0</td>
<td>22</td>
<td>49</td>
</tr>
<tr>
<td>9. Because of your problem, are you afraid to leave Your home without having someone accompany you?</td>
<td>12</td>
<td>0</td>
<td>37</td>
<td>49</td>
</tr>
<tr>
<td>10. Because of your problem, have you been Embarrassed in front of others?</td>
<td>7</td>
<td>0</td>
<td>42</td>
<td>49</td>
</tr>
<tr>
<td>11. Do quick movements of your head increase your Problem?</td>
<td>37</td>
<td>0</td>
<td>12</td>
<td>49</td>
</tr>
<tr>
<td>12. Because of your problem, are you afraid of heights?</td>
<td>17</td>
<td>0</td>
<td>32</td>
<td>49</td>
</tr>
<tr>
<td>13. Does turning over in bed increase your problem?</td>
<td>29</td>
<td>0</td>
<td>20</td>
<td>49</td>
</tr>
<tr>
<td>14. Because of your problem, is it difficult for you to do strenuous housework or yardwork?</td>
<td>26</td>
<td>0</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>15. Because of your problem, are you afraid people may Think you are intoxicated?</td>
<td>6</td>
<td>0</td>
<td>43</td>
<td>49</td>
</tr>
<tr>
<td>16. Because of your problem, is it difficult for you to Walk by yourself?</td>
<td>13</td>
<td>0</td>
<td>36</td>
<td>49</td>
</tr>
<tr>
<td>17. Does walking down a sidewalk increase your Problem?</td>
<td>13</td>
<td>0</td>
<td>36</td>
<td>49</td>
</tr>
<tr>
<td>18. Because of your problem, is it difficult for you to Concentrate?</td>
<td>12</td>
<td>0</td>
<td>37</td>
<td>49</td>
</tr>
<tr>
<td>Dizziness Handicap Inventory Questions.</td>
<td>Improved</td>
<td>Decreased</td>
<td>No Change</td>
<td>n</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-----------</td>
<td>----</td>
</tr>
<tr>
<td>19. Because of your problem, is it difficult for you to Walk around your house in the dark?</td>
<td>11</td>
<td>0</td>
<td>38</td>
<td>49</td>
</tr>
<tr>
<td>20. Because of your problem, are you afraid to stay home alone?</td>
<td>3</td>
<td>0</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>21. Because of your problem, do you feel handicapped?</td>
<td>14</td>
<td>1</td>
<td>34</td>
<td>49</td>
</tr>
<tr>
<td>22. Has your problem placed stress on your relationships With members of your family or friends?</td>
<td>5</td>
<td>0</td>
<td>44</td>
<td>49</td>
</tr>
<tr>
<td>23. Because of your problem, are you depressed?</td>
<td>14</td>
<td>0</td>
<td>35</td>
<td>49</td>
</tr>
<tr>
<td>24. Does your problem interfere with your job or Household responsibilities?</td>
<td>26</td>
<td>0</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>25. Does bending over increase your problem?</td>
<td>28</td>
<td>0</td>
<td>21</td>
<td>49</td>
</tr>
</tbody>
</table>
REFERENCES


