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The characteristics of individuals which influence vestibular therapy outcomes: A retrospective record review

A dissertation submitted to

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School of Human and Community Development

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Master of Arts in Audiology

by

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Declaration

I, Margot Hamman, hereby declare that the following dissertation was solely undertaken by myself and no help was provided from other sources than those allowed. All sections of the paper that use information developed by another author have been referenced. I am responsible for the content of the study and conclusions made. No part of this dissertation has previously been submitted for a degree at this or any other University.

Signature: _____ Date: _____

Margot Hamman

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List of Abbreviations

ABC:	The Activities-specific Balance Confidence Scale
ABR:	Auditory Brainstem Response
ADL:	Activities of Daily Living
BPPV:	Benign Paroxysmal Positional Vertigo
CN III:	Oculomotor nerve
CN IV:	Trochlear nerve
CN VI:	Abducens nerve
ENG:	Electronystagmography
ICF:	International Classification of Functioning, Disability and Health
OAE:	Otoacoustic Emissions
p-value	Probability Value
SCC:	Semicircular Canal
VOR:	Vestibulo-Ocular Reflex
VNG:	Videonystagmography
VRT:	Vestibular Rehabilitation Therapy
WHO:	World Health Organisation

Abstract

Purpose: In primary care settings, dizziness is reportedly one of the most common complaints seen by physicians (Desmond, 2004). Dizziness, although originating from many causes, often occurs from peripheral vestibular pathology (Kroenke, Hoffman & Eistandter, 2000). Vestibular rehabilitation therapy (VRT) is used to treat peripheral vestibular disorders. As with all therapy, patient characteristics often affect therapy outcomes. Research has been conducted into some of these characteristics and how they affect VRT, however patients often possess more than one of these characteristics. Little research has been conducted on multiple characteristics and how these characteristics influence each other. The current study aimed to address this shortcoming and aimed to identify therapy outcome indicators when looking at the patient holistically.

Data source: The research included the records from patients who underwent videonystagmography (VNG) testing and were referred for VRT at a balance and dizzy clinic in Johannesburg, South Africa between 2010 and 2013.

Design: A retrospective quantitative research design was used in this study.

Method: Once ethical clearance was obtained, the necessary information was extracted from the patients' files who provided informed consent and who met the inclusion criteria. The relevant information was tabulated and was analysed and interpreted using the relevant literature.

Data Analysis: To consider relationships of the variables in isolation, Chi-square tests and Spearman's correlation were used. A stepwise modelling method was applied. Decision tree models were used to investigate the effect of patient characteristics in combination.

Results: When looking at the characteristics individually, the presence of fluctuating dysfunction and balance confidence were found to influence vestibular therapy outcomes.

When looking at characteristics that would influence therapy outcomes in combination; the presence of fluctuating dysfunction, a low Activities-specific Balance Confidence Scale (ABC) score, right sided lateralisation of peripheral vestibular pathology and gender, specifically females, influenced vestibular therapy outcomes in a negative manner. A better ABC score, age above 50 years, no central signs and anxiety were also found to have positive bearing on vestibular therapy outcomes when found in combination.

Discussion, conclusion and implications: Fewer than hypothesised patient characteristics were found to be of influence when considering them in isolation. Looking at a patient from a holistic point of view was a specific highlight and further emphasised the need for researching patient characteristics in combinations. Examination of the influences to therapy outcomes in combination allows for the patient to be treated as a whole, ultimately leading to better patient care. The clinician should work within a multidisciplinary team, and understand that patient perception is often the largest influencer of all. The current study highlighted implications for the clinicians of today and the future, emphasising indicators which could potentially influence the therapy process. It also provided the clinician with information on the aspects which should be specifically addressed in order to prevent them from possibly influencing therapy outcomes. This study also identified the need for further research into combination of patient characteristics that would influence vestibular therapy outcomes. Future research should consider broadening the scope, looking at the private and public healthcare systems in South Africa and what therapy influencers may be at play in each dynamic. The characteristics that were identified were transferable, however additional characteristics may become relevant in difference environments. A longer time period with an objective as well as a subjective measurement should be considered. Lastly, the current study provides information in development of policy for public and private healthcare systems, providing realistic therapy time periods and resources for patients, as not all patients perform the same way in therapy.

Keywords: Peripheral vestibular pathology; Dizziness; Vestibular rehabilitation therapy; Patient characteristics

Chapter 1: Literature Review

1.1: The balance system

Balance can be defined as "the state of physical equilibrium (maintenance of one's centre of gravity within their base of support) achieved when vestibular, visual, and somatosensory information is integrated in the central nervous system and fed through an intact musculoskeletal system" (Bennett & Karnes, 1998, p. 182). As Bennett and Karnes (1998) so aptly express, the balance system allows for people to interact with their environment in a safe way.

There are two types of balance, static and dynamic balance. Static balance refers to balancing without movement, while dynamic balance refers to balancing with movement (Desmond, 2004). The vestibular system makes use of gravity as the reference, while the visual and somatosensory systems' references are constantly changing (Desmond, 2004). Due to gravity being the known constant variable, people tend to rely more on vestibular information for dynamic balance (Desmond, 2004). Allum and Pfaltz (1985) hypothesized that 65% of the information used for dynamic balance comes from the vestibular system. Static balance however makes use of somatosensory input as the predominant sense. If somatosensory input is not helpful, vision becomes the predominant sense (Desmond, 2004).

The vestibular system makes use of two main components: the peripheral component and the central component (Hamid & Sheykholslami, 2006). The peripheral component, known as the peripheral vestibular system is found in the labyrinth of the inner ear, within the petrous part of the temporal bone of the skull (Hamid & Sheykholslami, 2006). It is composed of three main aspects; the semicircular canals (SCCs), the otolith organs, and the vestibular nerves (Hamid & Sheykholslami, 2006). The SCCs consist of three canals which lie in the three planes of space; anterior, posterior and horizontal (Hamid & Sheykholslami,

2006), and are responsible for the detection of angular acceleration (Eisen & Limb, 2007). The otolith organs are comprised of the saccule and utricle and detect linear acceleration and gravity (Eisen & Limb, 2007; Hamid & Sheykholslami, 2006). The vestibular system makes use of sensory hairs or kinocilium which, in response to movement, either increase or decrease neurotransmitter release (Eisen & Limb, 2007). The two sets of vestibular sensory organs on either side of the head are responsible for measuring head motion and stability (acceleration). These vestibular end-organs on either side are paired and work in a push-pull manner. The left horizontal canal is paired with the right horizontal canal, and the left anterior canal is paired with the right posterior canal, while the right anterior canal is paired with the left posterior canal. These organs are in perfect equilibrium. When the one side increases its neural signal the other decreases its neural signal. This allows for the brain to interpret where the head has moved to and to what degree (Eisen & Limb, 2007). The central vestibular system occurs in the vestibular nuclei complex in the brainstem, where input is received from the vestibular nerves, reticular formation, cerebellum, neck and muscular structures and spinal cord. Here the information is analysed and adjustments are made to keep a person balanced (Friedman, Skobieranda & Hamid, 2006)

As mentioned above, many bodily structures are involved in the balance system. In order for balance to be maintained quick reactions and adjustments are required (Harsha, Phillips & Backous, 2008). Due to this, the vestibular system makes use of different reflexes. The three main reflexes that are utilized are the vestibulospinal reflex (VSR), the vestibulocolic reflex (VCR) and the vestibulo-ocular reflex (VOR) (Harsha et al., 2008). The VOR is responsible for maintaining stable visual input with head motion. It responds to stimulation within the SCC and otolith organs, and produces an equal but opposite movement of the eye to maintain fixation on a target (Hamid & Sheykholslami, 2006; Harsha et al.,

2008). The VSR is used to adjust posture during movement, while the VCR is used to stabilise the head in space (Harsha et al., 2008).

The blood supply to the vestibular system consists of the anterior vestibular artery and the posterior vestibular artery (Eisen & Limb, 2007). Innervation of the vestibular system branches from the vestibulocochlear nerve (CNVIII). From the CNVIII, it branches into the inferior and superior vestibular nerves (Eisen & Limb, 2007). The inferior portion innervates the posterior SCC and saccule; while the superior portion innervates the anterior and horizontal SCCs, utricle and part of the saccule (Hamid & Sheykholslami, 2006). Obstructions to either vascular or neural impulses may cause imbalance or dizziness, either temporarily or in a more permanent manner (Alpini, Cesarani & Brugnoni, 2014). Testing for these pathologies would require consultations with a cardiologist or neurologist (Alpini, et al., 2014).

1.2: What is dizziness?

"Dizziness and vertigo are not disease entities but rather the outcome of many pathological or psychological processes" (Brandt, 2000, p. 491). Dizziness and vertigo are one of the most common complaints made by patients seen in medical institutions (Newman-Toker et al., 2007). Also now considered separate descriptions. Vertigo and dizziness are often used interchangeably (Bisdorff, Von Brevern, Lempert & Newman-Toker, 2009). Bisdorff et al. (2009), in an attempt to develop international classification for vestibular disorders, developed the following definitions. Vertigo was defined as "the sensation of self-motion when no self-motion is occurring or the sensation of distorted self-motion during otherwise normal head movement" (Bisdorff et al., 2009, p. 5). Dizziness is described as "the sensation of disturbed or impaired spatial orientation without a false or distorted sense of motion" (Bisdorff et al., 2009, p. 7). Although not always falling within the abovementioned

definitions, patients who experience dizziness often report vertigo, giddiness, mild rotational feelings, off balance, unsteady, or veering to one side (Bronstein & Lempert, 2010). Any sensation of altered orientation in their environment is often termed dizziness (Baloh & Honrubia, 2001). According to Newman-Toker et al. (2007) most practitioners define four types of dizziness: vertigo, disequilibrium, non-specific dizziness and presyncope. Each directs a health professional towards a diagnosis (Newman-Toker et al., 2007). Research by Newman-Toker et al. (2007) found that patients use the term dizziness as an umbrella term for many symptoms and lack precision when relating their dizzy symptoms, highlighting its cautionary use.

1.3: Prevalence of dizziness and causes of dizziness

In the primary care setting, dizziness is reportedly one of the most common complaints seen by physicians (Desmond, 2004). According to Nazareth, Yardley, Owen, and Luxon (1999) 4% of patients within medical practices in London report persistent symptoms of dizziness, 3% of which consider their dizziness to be severely incapacitating (cited in Desmond, 2004, p. 1). Research conducted by Cheung et al. (2010), in an emergency department in China, found that 3.6% of the incoming cases presented with dizziness. According to Luxon (2004) one third of the population will experience a form of balance disorder by the time they are 60 years of age. Agrawal, Carey, Della Santina, Schubert and Minor (2009), based on the data from the national health and nutrition examination survey in the United States of America, found that 35.4% of adults over 40 years of age, would have vestibular dysfunction. They also found that once the adult is over 60 years of age, the prevalence of vestibular dysfunction is as high as 49.4% (Agrawal et al., 2009). A severe paucity of information appears to be present within the South African

context where little research could be found regarding the incidence of dizziness in this region.

According to Derebery (1999) the diagnosis of the causes of dizziness is considered a frustrating and challenging process for a clinician. Clinicians often report insufficient knowledge regarding the many causes and treatments of dizziness, and feel the diagnostic procedure is lengthy and often unsuccessful (Derebery, 1999). According to a review conducted by Kroenke, Hoffman and Eistandter (2000), of published articles on MEDLINE from the years 1966 to 1996, the most common causes of dizziness are peripheral vestibular disorders (44%). Following peripheral vestibular causes are central vestibular pathology (11%), psychiatric causes (16%), other conditions e.g. anaemia (26%), unknown causes (6%), cardiac arrhythmias (1.5%) and lastly brain tumours (<1%). The most common peripheral vestibular disorders, as suggested by Kroenke et al. (2000) include Benign Paroxysmal Positional Vertigo (BPPV); labyrinthitis and vestibular neuritis; and Ménière's disease. These are discussed below.

BPPV is hypothesised to be caused by displaced otoconia from the utricle, causing a larger reaction within the cupula of the SCC (Eisen & Limb, 2007). BPPV may occur in any of the SCCs, however the posterior SCC is the most common locus (Hamid & Sismanis, 2006). Patients with BPPV experience episodes of rotational vertigo, lasting a few seconds to minutes, which are evoked by head movement (Eisen & Limb, 2007).

Labyrinthitis and vestibular neuritis are defined as viral infections of the inner ear (Eisen & Limb, 2007). In the case of labyrinthitis the virus attacks the hearing and balance systems of the inner ear; while with vestibular neuritis, the virus is concentrated in the vestibular system of the inner ear (Brandt, 1991; Eisen & Limb, 2007;). Symptoms include sudden onset rotational vertigo lasting 24 hours to a week, nausea, vomiting, spontaneous nystagmus and postural instability (Brandt, 1991; Eisen & Limb, 2007). In the case of

labyrinthitis, symptoms also include hearing loss, tinnitus, a blocked sensation in the ear, and pain in the ear (McMenomey & Gubbels, 2008).

Ménière's disease is hypothesised to be caused by inadequate absorption of endolymph by the endolymphatic sac within the vestibular system (Eisen & Limb, 2007). Symptoms include rotational vertigo, lasting minutes to hours; roaring tinnitus; aural fullness; and fluctuating low frequency sensorineural hearing loss, that eventually becomes permanent (Eisen & Limb, 2007). Patients may also experience hyperacusis (hypersensitivity to sounds) and diplacusis (distortion of sound) (Hamid & Sismanis, 2006).

Other, less common peripheral vestibular pathologies include: perilymph fistula, ototoxicity, acoustic neuroma (vestibular schwannoma), mal de debarquement syndrome, superior canal dehiscence syndrome, and vertebrobasilar insufficiency (Desmond, 2004; Eisen & Limb, 2007). Disequilibrium due to aging (presbystasis), although not hypothesised to be solely due to the vestibular system, is common among the elderly (Rauch, Velazquez-Villasenor, Dimitri & Merchant, 2001). The presence of dizziness among the elderly has been reported to be as high as 50% (Rauch et al., 2001). The damage to the hair cells within the vestibular system is thought to be a contributing factor for the increased incidence of dizziness among the elderly; along with a decline in function of the visual, central nervous and musculoskeletal systems (Kim, Wilson & Wiet, 2008; Rauch et al., 2001).

1.4: Assessment of the vestibular system

Identifying the cause of a patient's symptoms is one of the most important steps when dealing with dizziness. It allows for accurate medical management, referrals, and rehabilitation; along with a better prognosis (Waldman & Brewer, 2007).

All vestibular assessments should begin with a thorough, holistic case history, conducted with understanding and in a compassionate manner (Bennett, 2008). The case

history is considered to be vital. It allows for the clinician to select the appropriate testing required, based on the presenting symptoms (Weber, 2008). There are many approaches or methods to obtaining a case history when working with vestibular pathology; however Van Ombergen, Van Rompaey, Van de Heyning and Wuyts (2015) broke the case history into eight sections. These included the symptoms experienced, the prevalence of the symptoms, the onset of symptoms, events that may cause the symptoms, concomitant otological symptoms, concomitant neurological symptoms, the changes to symptoms since the onset and how long the symptoms last. Limb and Ackley (2007) also highlight a few main aspects which should be included: the basic patient information; the main complaint; the onset of symptoms and changes to symptoms; the laterality of the lesion and additional auditory symptoms; the general health history; additional vestibular symptoms; the presence of headaches or neurological symptoms; dietary factors that are present; genetic involvement; the use of amplification; and a history of noise exposure. The last, but often more crucial aspect which should be included, is the patients' explanation of their dizziness, as different pathologies will present with different forms of dizziness (Weber, 2008).

Audiological assessments are often carried out as part of a full vestibular assessment. Within this audiological assessment, the following are included: otoscopic examination, immittance measurements, pure tone testing, and speech audiometry. Otoacoustic emissions (OAE) and auditory brainstem response (ABR) testing may also be carried out if necessary (Bhansali & Honrubia, 1999).

Videonystagmography (VNG) and electronystagmography (ENG) are the most common tools used to assess vestibular function (Bhansali & Honrubia, 1999). VNG and ENG testing attempt to identify nystagmus by measuring eye movements within different tasks (Bhansali & Honrubia, 1999). Advantages of these tests include: the ability to document nystagmus for better analysis, the ability to examine cerebellar modulated

voluntary eye movements, and the ability to test one labyrinth at a time (Bhansali & Honrubia, 1999). VNG systems are often favoured over ENG systems (Gans & Yellin, 2007). VNG also allows the clinician to observe torsional nystagmus which ENG does not (El-Kashlan & Handelsman, 2008; Hamid & Sismanis, 2006). VNG also provides cleaner tracings due to the lack of muscle artefacts and ambient noise disruptions (El-Kashlan & Handelsman, 2008). Although outweighed by its advantages, VNG testing does have some limitations. These include dark make-up and long eye lashes influencing the ability of the sensor to track the pupil, the one-size-fits-all goggle size, and the cost involved (El-Kashlan & Handelsman, 2008).

Throughout the VNG and ENG testing the clinician attempts to observe spontaneous nystagmus (Bhansali & Honrubia, 1999). Both VNG and ENG testing includes the tests traditionally used in a vestibular bedside assessment. The most common tests included are the ocular motor tests (saccades, smooth pursuit, and optokinetics); horizontal and vertical gaze test, with and without fixation; post-head-shaking eye movements; positioning tests; and bithermal caloric testing (El-Kashlan & Handelsman, 2008; Hamid & Sismanis, 2006). Caloric testing is arguably the most relevant test the audiologist possesses in diagnosis of peripheral vestibular weakness (Bhansali & Honrubia, 1999). It is the only test which assesses vestibular systems individually to one another and allows audiologists to measure the presence and degree of weakness in the horizontal SCC (El-Kashlan & Handelsman, 2008). There are many methods to conduct caloric testing, however the most common method involves water or air being inserted into each ear individually. The clinician can make use of either bithermal caloric testing, using water temperatures of both 30 and 44 degree Celsius; air temperatures of both 24 and 48 degree Celsius; or ice caloric testing, where ice water is used (El-Kashlan & Handelsman, 2008). The nystagmus reaction is observed as each horizontal SCC is stimulated individually (El-Kashlan & Handelsman,

2008). The reactions are measured and compared. Reactions should be fairly similar. According to Baloh and Honrubia (2001) the difference should be no more than 20%. A difference of 0-20% is considered normal, 21-25% is considered a mild pathology, 25-50% is considered a moderate pathology, while >50% is considered a severe pathology (Tusa, 2014).

Other essential vestibular tests that may be used include vestibular evoked myogenic potential (VEMP), video head impulse test (VHIT) and dynamic visual acuity (DVA). The vestibular evoked myogenic potentials (VEMPs) are thought to reflect otolith function. Two types of VEMPs exist. The cervical VEMP (cVEMP) is thought to evaluate the function of the saccule and inferior vestibular nerve while the ocular VEMP (oVEMP) is thought to assess the function of the utricle and superior vestibular nerve (Strupp & Brandt, 2013). The VHIT provides a means of individually assessing the horizontal, posterior and posterior canals individually (Shepard, Janky & Eggers, 2013). DVA measures the visual acuity of the patient while their head is in motion (Tusa, 2007). It is a useful test of function and is often used in vestibular rehabilitation (Tusa, 2007).

1.5: Vestibular rehabilitation therapy (VRT)

1.5.1: Therapy approaches to patient care

There are many approaches to the treatment of patients in a therapy session. The two general points of view are a reductionist approach to therapy, where patients are reduced to separate functioning body parts; and the holistic approach to therapy, where all the bodily functions are addressed as a whole (O'Brien, 2012). In the reductionist approach professionals managing the patient are specialised in that specific field or area, and treat these body functions independently, focussing on the specific problem (O'Brien, 2012). This approach allow for cures and technology development, however patients are often dissatisfied and feel the treatment is ineffective (O'Brien, 2012). An example of a reductionist approach

is the traditional medical treatment previously employed by doctors where the symptoms are treated without investigating the underlying cause (O'Brien, 2012). Based on the frustrations experienced by patients, the holistic approach has recently been favoured by medical professionals (O'Brien, 2012). Here the emphasis lies on the functional and organic relationship between the whole human being and the parts (O'Brien, 2012). These holistic elements include sociocultural, psychological, biological and spiritual elements; and their interaction with one another (O'Brien, 2012). Holistic treatment is based on the idea that if any element is disrupted the other elements are influenced (O'Brien, 2012). An example of the holistic approach to patient care is the medical professional looking at the whole person while treating the symptoms, the co-occurring difficulties experienced due to these symptoms, as well as addressing the underlying cause of these symptoms (O' Brien, 2012). VRT generally makes use of both the reductionist approach and holistic approach in therapy, the greater influence depending on the managing practitioner (Warner, Burgess, Patel, Martinez-Devesa & Corbridge, 2009).

1.5.2: What is VRT?

VRT is the choice management for many vestibular pathologies (Herdman, 2008). It is predominantly used in the management of unilateral peripheral vestibular pathology, bilateral peripheral vestibular pathology and BPPV (Herdman, 2008), although recent research has shown that VRT relieves the dizziness and imbalance experienced from many other pathologies, for example central pathologies (Furman & Whitney, 2000). The main goal of vestibular rehabilitation is to decrease the disability caused by the pathology, and not necessarily to alleviate the symptoms (Hamid & Samy, 2006). Often the disability that dizziness and imbalance causes to one's ability to function in everyday life is great, and although in some disorders all symptoms cannot be completely eradicated, the person is

provided with the tools necessary to return to as close as possible level of functioning that the person had prior to the onset of their symptoms (Hamid & Samy, 2006).

According to the International Classification of Functioning, Disability and Health (ICF), (2001, p. 213) a disability can be defined as "an umbrella term for impairments, activity limitations and participation restrictions. Disability denotes the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors)". "An impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations" (cited in World Health Organisation, 2011 p. 7). According to the World Health Organisation (WHO) World Report on Disability (2011), 15% of the world's population is estimated to live with some form of disability (p. 7). Although dizziness of vestibular origin is classified in the ICF, no information appears to be available regarding the prevalence of dizziness causing disability (ICF, 2001). With regard to dizziness and the disability experienced, Agarwal et al. (2000), found that the greater the dizziness the greater the disability. They suggested that dizziness affects people's ability to perform their basic activities of daily living (ADLs). The person with dizziness may feel unsafe doing more demanding activities due to fear of falling or obtaining an injury, therefore they restrict their activities (Agarwal et al., 2000).

1.5.3: Professionals who work with VRT

VRT is often managed by allied health professionals, specifically audiologists, occupational therapists, and physiotherapists (Hain, 2011). These professionals require training in the area of vestibular rehabilitation to ethically claim to be adequate at the skills needed to treat patients with vestibular pathology (Hain, 2011). In some cases patients obtain

a general set of exercises from doctors or external sources, such as the internet, and conduct these exercises in their own capacity. These exercises are often broad-set home programs not tailor-made for their abilities and level of stimulation necessary for compensation without overstimulation (Hain, 2011). Thus, these alternatives are not often recommended even though they may show some balance improvement. These exercise programs are not set at a level which stimulates the patient to the correct degree needed for compensation (Hain, 2011). Spontaneous recovery can occur, however this is more likely in the first few weeks following the onset, and is pathology dependent (Brandt, 1991). A customised and supervised therapy plan has more benefit, and ensures the exercises are conducted in a manner that is safe for the patient (Herdman, 2008). According to Herdman (2008) the success of VRT relies on the ability to accurately diagnose the cause of the dizziness, selection of the correct exercises needed for that pathology, knowing which characteristics would influence the therapy and how therapy should be modified, and knowing that not all patients will achieve ideal success in therapy. These reasons further highlight the benefit of a customised therapy plan, and management by a trained professional. In order to identify the aspects that can affect therapy and therefore allow for the therapist to make modifications to their therapy plan, research into characteristics that are an influence is needed.

1.5.4: Compensation

VRT makes use of different aspects to return people to a functional level of participation in their lives, of which compensation is the largest contributor (Hamid & Samy, 2006). Compensation is the mechanism for change in vestibular-ocular reflex and vestibulospinal reflex gains. These reflexes' gains are decreased when vestibular insult occurs (Toh, 2008). The structures within the vestibular system work as a unit. When moving the head to the right, the right horizontal SCC increases the rate of firing of the

neurons, while the left horizontal SCC decreases the rate of firing of the neurons (Toh, 2008). This signals the brain where and how quickly the head has moved (Toh, 2008). As with the right and left horizontal canals working in unison; the right anterior canal and left posterior canal are paired, and the left anterior canal and right posterior canal are paired (Toh, 2008). Although the strength of the vestibular system output is important, the fact that they are equal on either side plays a more crucial role (Toh, 2008). When damage has occurred within the vestibular system, one side has a weaker firing rate than the other, before head movement has even occurred. The brain therefore interprets this as movement towards the stronger vestibular system and the patient experiences this as dizziness (Toh, 2008).

Compensation occurs when the equilibrium is established again. This is accomplished through the unhealthy vestibular system's rate of firing being increased and the healthy vestibular system's rate of firing being decreased (Toh, 2008). An increase in head movement, as opposed to inactivity, enhances this process (Strupp, Arbusow & Brandt, 2001). The need to stimulate this compensation is one of the basic principles for VRT (Strupp et al, 2001) as dizzy patients have a tendency to avoid movements which induce symptoms. This results in a delay in natural compensation and the prolonging of symptoms (Hamid & Samy, 2006).

For some peripheral vestibular pathologies some level of spontaneous recovery occurs within the vestibular system in the first 1-6 weeks following the onset of damage. This is due to substitution for the vestibular deficit, central compensation and restoration of the damaged area (Brandt, 1991). However full recovery does not always occur. Bamiou, Davies, McKee and Luxon (2000) suggest that some patients with unilateral peripheral vestibular pathology can experience symptoms and the associated disability for up to five years post onset of symptoms. Each patient can react and present differently to the vestibular pathology. Many characteristics have been shown to influence the compensation for vestibular pathology, often

causing the above discussed disability of up to five years. Some of these characteristics that are able to influence vestibular therapy will be discussed in the course of this study. Research into the causes and better understanding of these characteristics will allow for clinicians to address them more effectively, and possibly shorten the period the patient will experience the residual symptoms from their vestibular pathology (Bamiou et al., 2000).

1.5.5: Principles of VRT

Three principles have been proposed to aid with overcoming vestibular pathology (Toh, 2008). The first is habituation. Habituation makes use of repeated exposure to provoking stimuli in the hope of symptom reduction in everyday movements and positions (Cawthorne, 1944; Cooksey, 1946; Toh, 2008). Patients generally begin at a level they are comfortable with and will increase in difficulty as success occurs (Herdman, 2008). The physiology of this mechanism is not well understood. Toh (2008) reports that it is hypothesised that by performing the repeated movements, the brain becomes accustomed to the movement and dizziness decreases. Habituation techniques have demonstrated less benefit in the case of patients with bilateral peripheral vestibular pathology, and therefore are not used for these patients (Herdman, 2008). Habituation is often used for patients with unilateral peripheral vestibular pathology, however VOR adaptation is more commonly used.

As discussed earlier, the VOR is used in stabilizing gaze during head movement, allowing for clear vision (Toh, 2008). VOR functioning requires an intact cerebellum; oculomotor nerve (CN III), trochlear nerve (CN IV), abducens nerve (CN VI); vestibular nuclei and labyrinth (Toh, 2008). The VOR adaptation principle is therefore not recommended for patients with central pathology, especially if the damage is in the cerebellum (Toh, 2008). VOR adaptation involves stimulating retinal slip, caused by the faulty system, in the hope of changing VOR gain (Toh, 2008; Zee, 2000). The retinal slip is

the movement of the image across the retina. The brain then receives an error message and encourages VOR adaptation. The brain attempts to limit the retinal slip by changing the gain of the vestibular response (Toh, 2008). Through these coordinated eye-head exercises, the vestibular system undergoes a long-term change of its neural response input (Herdman, 2008). In order for this to occur both visual input and movement of the body and head is required (Herdman, 2008). The most common exercises used are the times one (x1) viewing paradigm, where the target is stationary and the head moves; and the times two (x2) viewing paradigm, where the target and the head move in opposite directions (Herdman, 2008). This treatment is found to be most effective with patients with unilateral peripheral vestibular pathology (Herdman, 2008).

The third principle that may be used is sensory substitution. This involves using alternatives senses to overcome the faulty vestibular input, specifically somatosensory and visual cues (Shepard & Telian, 1995; Toh, 2008). The patient is attempting to use other systems to compensate for the vestibular loss, in the hope this will increase confidence, improve balance and decrease subjective dizziness (Toh, 2008). The cervico-ocular reflex has also been considered as an alternative mechanism, allowing for signals from the neck to help aid in head movements (Toh, 2008). Sensory input from the neck is thought to produce slow-phase eye movements opposite to the direction of the head movement. Therefore, exercises used in therapy would include slow trunk movements, while the head remains still (Schubert, 2014). Smooth pursuit and saccadic movements are also used at a low velocity, to aid in stabilising vision through pre-programming slow phases or decreasing corrective saccades (Toh, 2008). This treatment is used mostly for bilateral peripheral vestibular pathology and central pathology (Herdman, 2008).

Most therapists conducting VRT may make use of a combination of the three treatment principles discussed above. VRT is considered a fairly short-term therapy, with

success expected within 4-6 weeks from onset of the therapy in unilateral peripheral vestibular pathology, and three months in bilateral peripheral vestibular pathology (Herdman, 2008). Exercises are conducted for short periods of time, however are most effective when conducted multiple times during the day (Herdman, 2008). Most patients do have to continue with exercises long-term, to keep the level of recovery they achieved, however this can be conducted at home (Herdman, 2008).

1.6: Characteristics influencing success in VRT

Therapy outcomes are difficult to predict. Many aspects influence success in therapy. In the case of vestibular therapy, the assessment of the vestibular system identifies and quantifies some of these characteristics, allowing therapists to predict therapy outcomes to some degree (Slattery, Sinks & Goebel, 2011). Research is available regarding the effect of specific disorders that cause dizziness with some detail regarding the prognosis in vestibular therapy. Examples include a study by Topuz et al. (2004) who looked into the efficacy of VRT in chronic unilateral peripheral vestibular pathology, finding that improvement is experienced with supervised vestibular rehabilitation programs; and one by Zingler et al. (2008) who looked into degree of recovery in bilateral peripheral vestibular pathology, finding that 80% do not improve over time. There is however very little information available with regard to other patient characteristics and disorders which may influence therapy. Research is specifically lacking into how these characteristics interact with each other and the disorder.

For greater success in vestibular therapy, the therapy plan should be customised to each patient (Shepard & Telian, 1995). According to research conducted by Shepard and Telian (1995) patients who undergo custom therapy plans as opposed to generic therapy programs experience far greater success and better compensation. Within these custom made

therapy plans, patient characteristics regarding pathology, level of compensation, level of ability, as well as barriers to success need to be taken into account (Herdman, 2008). It is particularly important to take into account the possible barriers to success or difficulties patients may experience within therapy. This way counter measures or appropriate counselling can take place, and the success is maintained (Shepard & Telian, 1995). It is also vital to inform patients of the therapy process and what should be expected, as patient expectations also play a role in therapy outcomes (Shepard & Telian, 1995). In order to identify what the barriers to therapy success may be, research is needed. Without research into the aspects which may influence therapy, it becomes difficult to accurately advise patients and make the appropriate amendments. Properly informing patients becomes particularly vital with patients with a less positive prognosis, for example those with central pathologies or bilateral peripheral vestibular pathologies (Shepard & Telian, 1995). Accurate information and expectations allows for the patient to take responsibility for therapy. They need to understand that the therapy process only provides them with tools and techniques. The amount of success they experience depends on whether and how well the patient uses them (Shepard & Telian, 1995).

Many aspects interact and play vital roles in prognosis for therapy. Some are the diagnosis or diagnoses; others are patient characteristics and co-occurring pathologies. As will be discussed later, there has been some research into the area of patient characteristics, comorbid pathologies and diagnoses of dizziness; and how they influence therapy. This previous research is however limited and investigating combinations of influencing characteristics appears to be a fairly unique approach. As was mentioned earlier, the number of people who will experience some form of dizziness is fairly high. The causes for dizziness are vast and in the area of research into dizziness, identifying the patients who fit all the inclusion criteria of the study often limits the numbers. This is seen throughout research;

Zingler et al. (2008) had 82 participants; Bamiou et al. (2000) had 59 participants; Meli, Zimatore, Badaracco, De Angelis and Tufaralli, (2006) had 43 participants, and Kao et al. (2010) had 41 participants. This suggests the possible reason for the scarcity of research on combinations of patient characteristics in dizziness, as these multiple characteristics will further whittle down the numbers. Smaller numbers will make relevant statistical analysis of aspects in combination more difficult. This project looked to address this deficit of knowledge.

1.6.1: Age as a predictive factor for therapy outcomes:

According to Sturnieks, St George and Lord (2008) age is one of the largest contributing characteristic with regard to therapy outcomes. As discussed earlier, natural degeneration due to age occurs in the hair-cells within the vestibular end organs (Rosenhall, 1973; Sturnieks et al., 2008). Along with this, degeneration has been observed in the vestibular ganglion and nerve (Bergstrom, 1973; Richter, 1980; Sturnieks et al., 2008) as well as the cerebellar vermis (Kim et al., 2008). Visual acuity, depth perception and contrast sensitivity, and dark adaption also deteriorate with age (Sekular & Hutman, 1980). Musculoskeletal degeneration may also be observed, specifically loss of muscle and bone mass (Kim et al., 2008). When taking age and its effect on the prognosis for therapy, Shepard, Telian, Smith-Wheelock and Raj (1993) noted that elderly patients will experience success; the only difference they identified was the length of time it took them to get to maximum compensation. Other studies have found that with increased age, although success in vestibular therapy was found, the success was less and residual symptoms were more when compared to the younger population (Kammerlind, Ledin, Odkvist & Skargren, 2006). Kammerlind et al. (2006) hypothesised that this may be due to changes in the central nervous system and lower activity level.

When looking at rate of falls in the elderly from ages 65-84 years, Yasmura et al. (1994) found that the older groups had more falls than the younger groups. This was not found in research conducted by Downton and Andrews (1991), who found that there were no difference between ages. Their age ranged from 75-85 years. Taking this into account, along with Yasmura et al. (1994) this possibly suggests that age has less of an influence when under the age of 75 years. Hall, Schubert and Herdman (2004) also looked at age and its effect on reducing risk of falling with VRT, founding that age had no effect when reducing the risk of falling. They did however find that elderly patients are more likely to retain some risk for falling even after VRT (Hall et al., 2004).

1.6.2: The presence of fluctuating dysfunction as a predictive factor for therapy outcomes:

Fluctuating dysfunction of the vestibular system, such as endolymphatic hydrops and Ménière's disease, is often difficult to treat (Shepard & Telian, 1995). Research has shown that therapy may improve compensation, however the continuous fluctuating damage persistently increases the amount of asymmetry, therefore therapy outcomes are considered limited (Shepard & Telian, 1995). The frequency of the attacks impact on the length of time in therapy as well as the success experienced (Shepard & Telian, 1995). According to Luxon (2004), the cause for the limited success in therapy is due to the fact that in order for compensation to occur the vestibular disorder must be stable. He suggests that VRT is unhelpful until vestibular input is stable (Luxon, 2004). Herdman (2008) supports this statement, suggesting that patients with fluctuating dysfunction should be managed medically and surgically rather than with VRT.

1.6.3: The presence of migraines as a predictive factor for therapy outcomes:

True vertigo as well as dizziness have been described as possible symptoms of migraines (Babu, Rubin & Isaacson, 2008). Migraines occur with or without aura, and with or without headaches (Babu et al., 2008). Vertigo however is more likely to occur with patients with aura (Babu et al, 2008). Episodes last minutes to hours, and often presents similarly to Ménière's disease (Babu et al., 2008). Due to this, dizziness due to migraines is often misdiagnosed (Eisen & Limb, 2007). According to Oas (2002) and Sloan (1989) vestibular migraines are the most common central cause for dizziness. The Headache Classification Committee of the International Headache Society, in its most recent paper, The International Classification of Headache Disorders third edition (beta version) (2013), revealed criteria for the diagnosis of vestibular migraines. The general idea is that patients should have recurrent episodes of moderately or severe dizziness/vertigo, lasting five minutes to 72 hours, and should meet three of the migraine diagnostic criteria set out by them (p.794). Patients should have a history of migraines (Lempert et al, 2012). They may present with various types of vertigo or dizziness (Lempert et al, 2012). Other possible causes should also be ruled out (Lempert et al, 2012). Patients with vestibular migraines often do respond positively to traditional treatment used for peripheral vestibular disorders (Johnson, 1998; Oas, 2002; Oas, 2008), however the most common treatment is dietary or antimigrainous medication (Babu et al., 2008). Research into the area of treatment for vestibular migraines has shown that a combination of antimigrainous medication and VRT leads to better outcomes than purely medical management (Oas, 2002; Oas, 2008; Johnson, 1998).

1.6.4: Gender as a predictive factor for therapy outcomes:

Gender differences are often considered a relevant aspect that would influence therapy outcomes specifically with regards to postural control and functional mobility

(Vereeck, Wuyts, Truijen & Van de Heyning, 2008). Vereeck et al. (2008) hypothesised that this may be due to muscle strength and speed of muscle contraction. Downton and Andrews (1991) and Yasumura et al. (1994) all found that elderly women are more likely to fall than elderly men. The contrary has however been found by Bamiou et al. (2000) and Topuz et al. (2004) who identified that gender has little effect on the severity of disability in unilateral peripheral vestibular disorders.

Vereeck et al. (2008) took a closer look at gender, and found that when it comes to standing and forward reaching activities, gender differences were absent, however when looking at more functional posture control middle-aged women tended to perform more poorly (Vereeck et al., 2008). This suggests gender may have an influence on certain aspect of therapy outcomes, however not all aspects.

More women are found to experience dizziness than men (Cheung et al., 2010; Kammerlind, Ledin, Skargren & Odkvist, 2005; McGibbon et al., 2005). Whether this is due to women being more predisposed to experiencing dizziness or whether it is due to them being more likely to seek-help than men, is unknown. Much research has been conducted into the aversion of men to seek-help. It is thought that gender roles and masculine ideologies and norms, play a role in discouraging men to seek help from health services (Addis & Mahalik, 2003).

1.6.5: The presence of unilateral peripheral vestibular pathology as a predictive factor for therapy outcomes:

Unilateral peripheral vestibular pathology is the result of damage to one of the peripheral vestibular systems, either right or left (Kammerlind et al., 2005). Labyrinthitis and vestibular neuritis are one of the most common causes for unilateral vestibular pathology (Kroenke et al., 2000). Symptoms often include sudden onset vertigo and imbalance often

accompanied by nausea and vomiting. For the most part, episodes last a few days, after which symptoms resolve into slight imbalance (Kammerlind et al., 2005). Despite the cause, damage is often permanent. In order for the patient to overcome the symptoms caused by this damage, compensation needs to occur (Kammerlind et al., 2005). As compensation occurs, the symptoms that the patients experience lessen (Kammerlind et al., 2005). Once complete compensation has taken place, many patients return to previous levels of functioning (Kammerlind et al., 2005). Decompensation can occur. This happens for many reasons and involves the brain 'forgetting' what it has learnt in compensating for the damage (Shepard & Telian, 1995). Unilateral peripheral vestibular pathology, either uncompensated or decompensated, have the best overall prognosis for therapy, when compared to other vestibular pathologies (Shepard & Telian, 1995). Hall et al. (2004) found that patients who were at risk for falling with unilateral peripheral vestibular pathology have decreased risk for falling following VRT.

1.6.6: The presence of bilateral peripheral vestibular pathology as a predictive factor for therapy outcomes:

Management of patients with bilateral peripheral vestibular pathology is challenging due to the severity of the disability that is associated with it (Brown, Whitney, Wrisley & Furman, 2001). Bilateral peripheral vestibular pathology involves damage to both peripheral vestibular systems (Petersen, Straumann & Weber, 2013). Patients usually do not experience vertigo as a symptom, because both vestibular systems are affected, and may or may not experience hearing loss. The most common symptoms are chronic dysequilibrium and/or oscillopsia (Petersen et al., 2013). Although there are many causes of bilateral peripheral vestibular pathology, the most common include vestibulotoxicity, autoimmune ear disease, and meningitis (Petersen et al., 2013). Bilateral peripheral vestibular pathology, in

comparison to unilateral peripheral vestibular pathology is a more rare pathology. Research conducted by Tabak, Collewijn and Boumans (1997), when looking into patients subjective visual vertical, found that of the patients included in the study 25 had no vestibular loss, 39 had either partial or complete peripheral vestibular pathology, and 8 had suspected bilateral peripheral vestibular pathology. Therapy has proven to aid many patients' overall balance and compensation for bilateral peripheral vestibular pathology; however patients are often left with residual symptoms. Research suggests that the presence of bilateral peripheral vestibular pathology would cause patients to experience less success in VRT than those who do not have bilateral peripheral vestibular pathology (Brown et al., 2001; Gill-Body, Beninato & Krebs, 2000; Gillespie & Minor, 1999; Hall et al., 2004; Telian, Shepard, Smith-Wheelock & Hoberg, 1991).

1.6.7: The degree of vestibular asymmetry as a predictive factor for therapy outcomes:

There is contradictory research as to the effect the degree of peripheral vestibular loss will have on vestibular therapy outcomes. Damage may occur bilaterally, however the difference between vestibular systems is thought to influence therapy outcomes. According to research conducted by Bjerlemo, Kollen, Boderos, Kreuter and Moller (2006); and Kammerlind et al. (2005), the larger the degree of asymmetry the more likely the person is to have spontaneous nystagmus, longer periods of sick leave and larger sense of unsteadiness. Shepard and Telian (1995) found that substantial loss of function of any balance system will limit success in therapy. Contrary to these findings Bamiou, Davies, Luxon and McKee (1999) found that patients with partial canal paresis experienced greater dizziness and disability when compared to those with complete canal paresis. This was hypothesised to be due to the fact that contradictory signals from partial paresis may delay compensation within

the brain, while cerebral plasticity would be unchallenged in complete paresis (Bamiou et al., 1999)

1.6.8: Length of time from onset of symptoms to onset of therapy as a predictive factor for therapy outcomes:

With regard to length of time from onset of symptoms to onset of treatment as a predictive factor for therapy outcomes, it is thought that VRT should be initiated as soon as the patient can endure it, as by doing so the patient is less likely to develop chronic symptoms (Hamid & Sismanis, 2006). Research conducted by Bamiou et al. (1999) found that patients who began VRT earlier had lower disability scores than those who began VRT later, when measuring from the onset of symptoms to the start of VRT. This suggests patients who underwent early identification of vestibular weakness and early implementation of VRT had less disability. Their research also showed that non-compliance and delay of implementation of VRT led to increased perceived handicap and disability (Bamiou et al., 2000). Mendel, Bergenius and Langius (1999) also found that the longer those patients had the disorder the more likely they were to report anxiety, disease specific handicaps and decreased psycho-social functioning. Contrary to the above findings Hall et al. (2004) found that length of time from onset of symptoms to initiation of rehabilitation did not influence the benefit of the VRT, although still highlighted the importance of beginning vestibular therapy as early as possible to avoid falls. The range of the time from onset of symptoms to onset of therapy was not presented in their research, however the mean was 12 months (Hall et al., 2004). Research by Bamiou et al. (2000) included patients with a time period from onset of symptoms of six months to five years, with a mean of three years. Perhaps when comparing the patients who were included in these studies, little effect is seen when patients begin vestibular therapy prior to 12 months form onset of symptoms.

1.6.9: Balance confidence as a predictive factor for therapy outcome:

Reduced confidence in a person's ability to maintain balance may lead to avoidance behaviours and thus may affect therapy outcomes (Powel & Myers, 1995). A patient with increased head movements, as opposed to inactivity, ensures faster compensation for vestibular pathology (Strupp et al., 2001). Apart from this, research has shown a correlation between lower confidence and poorer walking ability (Legters, Whitney, Porter & Buczek, 2005). According to Staab (2011), due to these factors, balance confidence and belief of handicap are the most predictive characteristics for developing chronic vestibular symptoms. This was also found in research conducted by Whitney, Wrisley, Brown and Furman (2004), who found that less carry-over occurs in the home environment. In order to address this it is necessary for the patient's confidence to be assessed. The Activities-specific Balance Confidence Scale (ABC) has shown to be useful in identifying patients who have low confidence in activities, as well as is a reliable measure of physical performance (Botner, Miler & Eng, 2005; Jarlsater & Mattson 2003; Powell & Myers, 1995). The ABC was developed to allow for a wider range of difficulty as well as more detailed items. It is considered a reliable measure of balance confidence. Research has shown it to be internally consistent, with good test-to-test reliability and validity (Powell & Myers, 1995). When looking at the overall average ABC score, a score above 80% is considered a high level of confidence, a score between 50% and 80% is considered a moderate level of confidence, while a score less than 50% is considered a low level of confidence (Myers, Fletcher, Myers & Sherk, 1998). Myers et al. (1998) suggest that these levels of confidence allow the therapist to distinguish between patients at various levels of functional mobility.

1.6.10: The presence of comorbid pathology/ies as a predictive factor for therapy outcomes:

When two separate conditions occur simultaneously, this is known as comorbidity (Feinstein, 1970). According to Feinstein (1970), who coined the term comorbidity, when looking specifically at multiple diseases, neglecting the presence of the comorbid pathology has detrimental effects on evaluation of treatment of the patient. He highlighted that when comparing patients these aspects need to be considered to ensure you are evaluating the correct aspect. Comorbid pathologies can affect "time of detection, prognostic anticipations, therapeutic selection, and post-therapeutic outcome of the index disease" (Feinstein, 1970, p. 467).

According to the definition set out by Freinstein (1970), an association between a peripheral vestibular pathology and another condition can be considered comorbidity. The presence of comorbid pathologies or comorbidities are fairly common, and according to a review conducted by Maj (2005) is more frequent today than in the past. These pathologies are sometime pre-morbid to the dizziness, for example diabetes (Gawron, Pospiech, Orendorz-Fraczkoowska & Nocztnska, 2002); while others could be either pre-morbid or occur due to the dizziness. For instance the development of anxiety could possibly be due to the dizziness the patient is experiencing or could have been present prior to the dizziness and simply exacerbated by the dizziness (Baloh & Honrubia, 2001). A common comorbid pathology that is known to present with anxiety is persistent postural and perceptual vertigo, a pathology where postural dizziness or fluctuating dizziness is provoked by environmental or social stimuli (Bittar & Lins, 2014).

Many pathologies cause dizziness either as one of the symptoms of the pathology, or through the medication used to treat for the pathology (Herdman, 1997). These comorbid pathologies would therefore have a significant influence on the diagnosis and management of

the patient (Herdman, 1997). In the planning of vestibular therapy, comorbid pathologies are often highlighted as a characteristic to consider (Herdman, 1997). Little research has been conducted on the impact of comorbid pathologies on vestibular therapy, and how vestibular therapy is affected when these comorbid pathologies are found in combination. According to Black and Pesznecker (2003) the best therapy outcomes will occur when patient therapy plans account for comorbid pathologies, which so often present with patients with vestibular pathology. The comorbid pathologies that were included in this study were diabetes, neck stiffness, circulatory or vascular problems, osteoporosis and/or arthritis, epilepsy and/or seizures, and thyroid problems. These were included as these characteristics all may cause some form of dizziness, and are specifically indicated in the entry assessment form filled out by all patients in the clinic.

1.6.10.1: The presence of diabetes as a predictive factor for therapy outcomes

Patients with Type I diabetes are known to present with damage to the central part of the vestibular organs (Gawron et al., 2002). The degree of damage depends on the management of the diabetes, the length of time the patient has had the diabetes, and the presence and characteristics of hypoglycaemic incidents (Gawron et al., 2002). According to Myers and Ross pathological changes can also occur to the saccule and utricle (as cited in Neuhauser et al., 2005). Apart from the damage to the structures within the inner ear, patients with more severe neuropathies from their type I diabetes are significantly less stable and demonstrate difficulty in maintaining posture (Oppenheim, Kohen-Raz, Kohen-Raz & Azarya, 1999; Uccioli et al., 1995). Agrawal et al. (2009) found that vestibular dysfunction is 70% higher in people who have diabetes. These above researches all suggests that the presence of diabetes would cause more damage to balance systems, and less success in therapy; when compared to those without diabetes.

Contrary to the above findings however, Neuhauser et al., (2005) have shown that there is no significant association between subjective vestibular symptoms and diabetes. Their research suggests that once corrected for age and sex the association between diabetes and vestibular vertigo is minimal (Neuhauser et al., 2005).

1.6.10.2: The presence of anxiety as a predictive factor for therapy outcomes

Dizziness has a tendency to cause a lot of anxiety in patients, therefore it is common to find anxiety and dizziness co-occurring (Beidel & Horak, 2001). Anxiety can also manifest as dizziness (Baloh & Honrubia, 2001). This anxiety is associated with a number of neurologic or psychiatric disorders as well as general circumstances of daily life (Baloh & Honrubia, 2001), thus making this presentation fairly common (Baloh & Honrubia, 2001). Research has shown that the presence of anxiety disorders can influence progress in therapy (Beidel & Horak, 2001). Beidel and Horak (2001) however do state that it is difficult to identify whether the presence of the anxiety is causing the prolonged symptoms or whether the vestibular pathology is causing the prolonged symptoms (Beidel & Horak, 2001). Another pathology which can be associated with anxiety is persistent postural and perceptual dizziness. These patients present with persistent dizziness or instability which has no physical presentation (Bittar & Lins, 2014). Their symptoms will worsen with head movement or busy visual stimulus and are known to also present with anxiety (Bittar & Lins, 2014).

VRT has proven effective when anxiety is mild. However when anxiety is more severe psychiatric intervention may be necessary (Shepard & Telian, 1995). According to Staab (2011), psychological characteristics are the strongest predictors of developing chronic vestibular symptoms. These psychological characteristics include predisposition to anxiety, worry about the aetiology and consequences of the vestibular pathology, and believing that the vestibular pathology is a handicap (Staab, 2011).

1.6.10.3: The presence of neck stiffness as a predictive factor for therapy outcomes

Cervical dizziness, otherwise known as cervicogenic balance disorders, proprioceptive vertigo or cervicogenic vertigo, is dizziness caused by some form of a pathology in the neck (Alpini et al., 2014). The exact pathophysiologic mechanism is unknown, however many authors feel the dizziness is due to some form of obstruction of either neural or vascular inputs in the neck region (Alpini et al., 2014). Cervical proprioception for motor control and posture control has been well documented and therefore it is logical to infer that difficulties in that area can cause dizziness (Karlberg, Magnusson, Malmstrum, Melander & Moritz, 1996). Due to the poor definition of cervicogenic dizziness and the shortfall of reliable tests to assess for it, vertigo due to neck disorders has become an area of great debate (Karlberg et al., 1996). Much research has been conducted in the area, and cervicogenic dizziness is regularly considered a distinct disorder (De Jong, De Jong, Bernard & Jongkees, 1977; Karlberg et al., 1996; Luxon, 1984; Ried & Rivett, 2005). Treatment for this differs greatly to that of treatment for peripheral vestibular pathology. Traction of the neck, immobilisation, local anaesthetics, soft tissue treatments, mobilisation, ergonomic changes, stabilisation of the trunk and cervical spine, and manual therapy are all methods that are used when treating cervicogenic dizziness (Karlberg et al., 1996; Ried & Rivett, 2005). It can therefore be hypothesised that additional and possibly alternative treatment is needed for patients with cervicogenic dizziness, than what is usually conducted in vestibular rehabilitation.

1.6.10.4: The presence of central signs as a predictive factor for therapy outcomes

Often patients with damage to the central vestibular structures, for example anywhere in the vestibular nuclei complex, may experience vertigo, imbalance or dizziness (Olshaker, 2010). The onset of symptoms can be gradual or sudden and are usually mild in intensity.

Symptoms often have occurred for long periods of time, usually more than a week; and are usually constant (Olshaker, 2010). Due to compensation occurring centrally, often patients with associated central pathology need longer periods of rehabilitation (Furman & Whitney, 2000; Konrad et al., 1992; Shepard et al., 1993). Patients who have both peripheral disorders and central disorders experience less success in vestibular rehabilitation therapy than a purely peripheral vestibular disorder (Shepard et al., 1993).

1.6.10.5: The presence of circulatory or vascular disorders as a predictive factor for therapy outcomes

Circulatory or vascular disorders have been shown to cause dizziness or even true vertigo (Newman-Toker et al., 2008). Research conducted in emergency rooms in the United States found that 21.1% of people who complain of dizziness have cardiovascular disease (Newman-Toker et al., 2008). In addition to vascular and circulatory diseases causing dizziness, degeneration of the vascular system in the elderly contributes to poor blood supply and increases the possibility of vertigo (Yin, Ishikawa, Wong & Shibata, 2009). The treatment of dizziness caused by circulatory or vascular disorders is different to vestibular pathology. Also if the dizziness is caused by both a circulatory or vascular disorder, and vestibular pathology, then treatment of only the vestibular pathology would leave some dizziness as the circulatory or vascular disorder has not been addressed (Yin et al., 2009). Due to this additional cause of dizziness, it is hypothesised that these patients should therefore experience less success in vestibular therapy than those without circulatory or vascular disorders. The successful management of the circulatory or vascular disorder would also then play a role.

1.6.10.6: The presence of osteoporosis and/or arthritis as a predictive factor for therapy outcomes

It is difficult to separate the other causes of dizziness that occur with age from those that are caused by osteoporosis and/or arthritis, as osteoporosis and/or arthritis is often a late onset condition (Tusa, 2007). Osteoporosis and/or arthritis will limit movements and, depending where the osteoporosis and/or arthritis is, can cause disuse disequilibrium or fear of falling (Tusa, 2007). Limited movements also limit the stability of the person, and cause a decline in muscle bulk, joint range of motion and reflex time (Lyles, Schenck & Colon-Emeric, 2007). Although osteoporosis and/or arthritis does not cause dizziness itself, depending on the location, it may cause impaired balance (Stevens, Lang, Guralnik & Melzer, 2007). According to Black and Pesznecker (2003) movement or orthopaedic disorders will severely affect VRT's ability to resolve fear of falling and unsteadiness.

1.6.10.7: The presence of epilepsy and/or seizures as a predictive factor for therapy outcomes

Aside from dizziness being one of the many side effects of anti-epileptic medication, epilepsy has been known to cause episodic dizziness in some patients (Erbayat Altay et al., 2005). Dizziness from epilepsy is more common in patients with temporal lobe epilepsy (Kogeorgos, Scott & Swash, 1981). The cause of the dizziness is thought to be due to the vestibular system projecting signals to the temporal lobe. This is thought to be the reason for the similar presentation to a peripheral vestibular pathology (Kogeorgos et al., 1981). Episodes have been described to last a few seconds and are not associated with postural change. Dizziness due to epilepsy is often mistaken for BPPV (Erbayat Altay et al., 2005). Treatment for dizziness due to epilepsy involves mostly management with medications, and is very different to that of peripheral vestibular disorders (Erbayat Altay et al., 2005;

Kogeorgos et al., 1981). If the wrong treatment is given, it is expected that the patient would not improve. Another aspect which should be considered is if the patient has epilepsy and another vestibular pathology, the presence of the epilepsy may cause dizziness on top of the dizziness from the vestibular pathology. It is therefore thought that the patient would experience less success in VRT than one with a purely peripheral vestibular pathology.

1.6.10.8: The presence of thyroid problems as a predictive factor for therapy outcomes

The thyroid is a gland found in the body which produces hormones which regulate the body's metabolic rate, temperature, growth and mental development; as well as controlling oxygen consumption (Behrbohm, Kaschke, Nawka & Swift, 2009). Thyroid disease is either an overproduction (hyperthyroidism) or underproduction (hypothyroidism) of these hormones (Hoffer, Balough & Gottshall, 2008). Dizziness is one of the most common symptoms of both hyperthyroidism and hypothyroidism (Hoffer et al., 2008). Laboratory evaluations of the thyroid are helpful in diagnosing thyroid disease. When diagnosed treatment is related to management of the thyroid (Hoffer et al., 2008). For this research it is thought that the presence of more dizziness due to a thyroid disorder may cause the participant to perform worse than those without thyroid difficulties. This is heavily dependent on how well the thyroid problem is managed. Patients who are managed well will experience fewer symptoms and have better overall bodily function (Behrbohm et al., 2009).

1.6.11: Lateralisation of peripheral vestibular pathology as a predictive factor for therapy outcomes

Lateralisation of peripheral vestibular pathology refers to the side of the peripheral vestibular pathology. Very little research has been conducted into the lateralisation of

peripheral vestibular pathology. In fact many researchers do not even mention the division of right versus left sided peripheral vestibular pathology in their demographic information of the participant sample. Research conducted by Tabak et al. (1997), when looking into patients' subjective visual vertical, found that 33% had left and 67% had right sided peripheral vestibular pathology. Their research suggested that unilateral peripheral vestibular pathology causes subjective vertical tilt towards the side of the lesion. These patients will perceive vertical to be leaning towards the side of the lesion and not true vertical. For example, if a patient has a right peripheral vestibular pathology, they will perceive true vertical to be tilted to the right. Due to this tilt, patients will fall towards the side of lesion, in this example they will fall to the right (Tabak et al., 1997). Bamiou et al. (1999) found that participants with total canal paresis were more likely to have this damage on the left side. They hypothesised that perhaps this may be due to an anatomical variation where the left vestibular organ is more vulnerable (Bamiou et al., 1999). Their research also noted that the lateralisation made no difference to the vestibular therapy outcomes (Bamiou et al., 1999).

1.6.12: Single versus multiple diagnoses for the dizziness as a predictive factor for therapy outcomes

Dizziness often has multiple diagnoses as the cause. Not all causes are ear related, and therefore practitioners are often asked to work in a multidisciplinary team when treating dizziness. Ardic, Topuz and Kara (2006) conducted research into multiple causes of dizziness and found that 61.6% of patients were diagnosed with one diagnosis, while 38.4% had multiple (1-4) diagnoses. Tinetti, Williams and Gill (2000) conducted research in dizziness in the elderly, finding that multiple diagnoses ranged from 0% to 85%. They suggested that the range is due to the difference in population, however suggested that dizziness may not be solely from isolated diseases, instead it may be multifactorial. They

also suggested that the elderly population are more likely to present with multiple causes of dizziness than single causes. On the contrary to the above findings, Ardic et al. (2006) reported that they found no difference with regard to the patients' functioning in the presence of multiple diagnoses versus single diagnosis. They did however found that patients with multiple diagnoses' emotional and physical handicaps were greater.

1.7: Rationale for the research study

Dizziness is a complex pathology. It can have a peripheral and/or central and/or even psychogenic cause. Even after the cause is identified, the treatment is often influenced by many aspects. Several have been discussed above, specifically: age, fluctuating dysfunction, the presence of migraines, gender, the degree of the pathology, the length of time from onset of symptoms to the onset of vestibular therapy, balance confidence, unilateral versus bilateral peripheral vestibular pathology, the comorbid pathologies that often accompany the dizziness, multiple comorbid pathologies, lateralisation of peripheral vestibular pathology and single verses multiple diagnoses for the dizziness. Some of these areas have already been researched when it comes to dizziness and vestibular pathology, however conflicting research is present for most. These areas were also investigated in isolation and, as seen in practice, this is rarely the case. Patients often have more than one aspect which will influence their success in therapy.

There is very little research has been conducted in the field of dizziness in South Africa, specifically in the area of patient characteristics and their influence on vestibular rehabilitation therapy. Much of the research conducted in the field of dizziness has been conducted in the United States of America and Europe.

South Africa is often considered a third world country, where access to basic healthcare and basic services can be more challenging than elsewhere (Pillay, 2009). The

healthcare system has varying avenues, some of which include the public healthcare system and the private healthcare system. The public healthcare system consists of government institutions, and is in general accessed by the population who are unable to afford insurance for medical benefits (Pillay, 2009). The private healthcare systems are private profit organisations that are accessed mostly by the population who are able to afford insurance for medical benefits (Pillay, 2009). In South Africa a large inequality is present between income brackets which in turn has placed a large financial burden on the health care system. This has led to insufficient health care services and resources for the demand placed on the government (Coovandia, Jewkes, Barron, Sanders & McIntyre, 2009). These factors are largely the driving force towards the development of the private healthcare system (Coovandia et al., 2009). In Johannesburg, where the current study took place, there are few multidisciplinary vestibular assessment and rehabilitation clinics. In total there are four, two of which are within public sectors and two of which are in private sectors. Resources available as well as differences in staffing demands are seen when comparing private and public sector facilities.

Some research has been conducted regarding immunodeficiency and dizziness in South Africa, finding that patients with immunodeficiency may present with dizziness and should monitor their vestibular functioning (Heinze, Swanepoel & Hofmeyr, 1984). Research has also been conducted on the incidence of acoustic neuromas in South Africa, finding that the incidence of acoustic neuromas in South Africa is 0.3 per 100 000 per year (Seedat, Classen & Mol, 2002). It is therefore extremely relevant to provide more information into the presentation of dizziness in South Africa, as treatments may be influenced by other factors, making research into this field germane and in fact necessary.

Research into this area provides clinician with greater understanding on how these variables influence therapy outcomes as well as how these variables interact. The ability to

provide a more accurate account of therapy outcomes allows for clinicians to fully prepare patients for the road ahead, addressing the emotional ties dizziness brings to therapy and allowing patients to take ownership of their progress. By having access to this information it also allows patients to prepare for the financial burden they may encounter. For therapists and clinics, it allows for information on what expenses patients will incur, resources that may be needed, and the allotted time periods each patient will need. It will also allow for better structured therapy protocols. Research into this area also allows for growth of the services being provided to people with dizziness to ensure the best possible service and a realistic expectation of what is needed.

Chapter 2: Method

The current study was conducted in the field of dizziness, looking at which characteristics, singly and in combination, are able to influence vestibular therapy outcomes. In the write up of the study, the term "patient" is used when referring to people who were accessing services at the clinic and the same term is used when referring to the participant in that role. However, in the context of the study where patients agreed to participate in this project and reference is made to their records, they are referred to as participants. From a target of 181 records, this research made use of 85 retrospective records which were analysed and conclusions were drawn.

2.1: Aims of the study

2.1.1: Primary aim

To explore the effect of patient specific characteristics on therapy outcomes in VRT, in a private practice multidisciplinary team setting in Johannesburg, South Africa.

2.1.2: Specific objectives

` To determine and describe:

- The effect of age on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect fluctuating vestibular dysfunction has on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect the presence of migraines has on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.

- The effect of gender on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of balance confidence on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of unilateral versus bilateral vestibular loss on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of the degree of peripheral vestibular asymmetry on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of the length of time from onset of symptoms to the onset of vestibular rehabilitation on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of associated comorbid pathologies on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes. Specific comorbid pathologies were selected based on the pathology's symptoms or treatment causing dizziness. The comorbid pathologies that were thus included were:
    - Diabetes.
    - Anxiety.
    - Neck stiffness.
    - Central signs.
    - Circulatory or vascular problems.
    - Osteoporosis and/or arthritis.
    - Epilepsy and/or seizures.
    - Thyroid problems.
- The effect of multiple comorbid pathologies on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.

- The effect of the lateralisation of peripheral vestibular pathology on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.
- The effect of single versus multiple diagnoses for the dizziness on VRT outcomes and how this interacts with other characteristics to influence therapy outcomes.

2.2: Research question

What are the patient specific characteristics that may influence vestibular therapy outcomes, and in what way do they affect vestibular therapy progress?

2.3: Hypotheses

Based on the literature review, it was hypothesised that the presence of:

- increased age,
- and/or larger degree of peripheral vestibular weakness,
- and/or longer time periods between onset of symptoms and initiation of VRT,
- and/or bilateral vestibular weakness,
- and/or fluctuating dysfunction,
- and/or less balance confidence,
- and/or the participant presenting with migraines, and/or any of the comorbid pathologies,
- and/or multiple comorbid pathologies,
- and/or multiple diagnoses for the dizziness

would negatively affect therapy outcomes. It was hypothesized that the more characteristics the participant had the more negatively affected the VRT therapy outcome would be. Gender and lateralisation of peripheral vestibular pathology was hypothesised to have no significant influence on VRT outcomes. Although some research has been found to

suggest gender may influence vestibular therapy outcomes, this hypothesis is in agreement to Bamiou et al. (2000) and Topuz et al. (2004).

2.4: Research Design

A retrospective quantitative research design was used in this study. Retrospective designs are often used to identify trends (Kumar, 2011) and provide proof towards the effectiveness of services (Drummond, 1996). This is done with the use of data collected in the past (Kumar, 2011), and provides us with a global perspective of situations or subjects over a span of many years (Drummond, 1996). Retrospective data analysis is an exceptionally important aspect to allow for growth in patient management, and should be considered by all practitioners in their clinical environment (Kumar, 2011). The downfall of retrospective research is the inability to obtain data if they are not present, as well as high numbers of records are needed for relevant trends to be identified (Kumar, 2011). These downfalls were addressed using strict inclusion and exclusion criteria and these will be discussed shortly.

2.5: Description of the records that were reviewed

2.5.1: Clinic Protocol

A private practice clinic was chosen as it is in the private sector where a majority of vestibular work is being conducted and data is therefore more readily available. As discussed earlier, few multidisciplinary vestibular assessment and rehabilitation clinics exist. In Johannesburg two government facilities provide vestibular assessment and treatment. One additional government facility is in the process of establishing a vestibular assessment and treatment clinic. Only one other private facility provides vestibular assessment and treatment, while three audiology private practices provide only the assessment of the

vestibular system, and two physiotherapy private practices are specialised in only vestibular treatment. This provides Johannesburg with two private multidisciplinary teams for vestibular assessment and rehabilitation; two, going on three, government multidisciplinary teams for vestibular assessment and rehabilitation; and five either assessment or treatment private clinics.

Patients are referred to the participating clinic via many different avenues. Some of these referrals are from doctors or allied healthcare professionals, while others are from the patients referring themselves.

Patients in the clinic are required to fill in an information booklet detailing their age, gender, for how long they have been dizzy, a description of the dizziness as well as any comorbid pathologies. They are then assessed by an audiologist, using VNG testing, to assess whether a vestibular pathology is present and whether vestibular rehabilitation therapy is necessary. VNG testing includes case history, ocular motor testing (smooth pursuit, saccadic testing and optokinetic testing), gaze testing (with and without fixation), positional testing (Dix-Hallpike and head roll testing), and caloric testing. Some patients undergo audiological testing as well and are managed by the audiologist from the hearing perspective if needed. Based on the test results, should the audiologist deem that vestibular therapy is needed, the patients are then managed by the physiotherapist in the team. Criteria for vestibular rehabilitation referral includes, identification of peripheral vestibular pathology or disruptions to activities of daily living due to their imbalance or dizziness, no matter the cause. Patients complete an ABC scale and their general balance, muscle strength, and level of compensation for symptoms are assessed. Personalised vestibular therapy plans are drawn up based on the information gathered to that point in time. Patients are then seen once a week by the physiotherapist, where the exercises are completed and modified if necessary. At the beginning of every session, patients are required to rate their dizziness out of five,

from zero being “no dizziness” to five being “very dizzy”. Following three weeks of therapy, the physiotherapist then evaluates whether therapy should be extended or terminated. The clinic decided on a three week re-assessment marker, as medical aids often require motivation for long periods of physiotherapy. For this reason the three week time period was chosen for this research.

2.5.2: Participants

All patients who were included in this study will be referred to henceforth as participants, as they do not fall under a therapy-patient relationship with the researcher. Specifically, the participants who were patients of the researcher, no longer fall under a therapy relationship as they are no longer the researcher’s patients.

2.5.2.1 Participant selection – Inclusion/exclusion criteria

Participants who were included in this study specifically met with the following requirements:

The participants had to:

- have been seen at the specific balance clinic used for this research, in the northern suburbs of Johannesburg, between January 2010 and December 2013. This timeframe was utilized as this was the timeframe where full years of patient files were available.
- have undergone a VNG assessment in that time period. This information from the VNG was used in obtaining some of the characteristics, specifically the degree of asymmetry from caloric testing, and the presence of central signs from ocular motor tests or horizontal nystagmus in gaze testing.

- have undergone vestibular rehabilitation therapy for three weeks or longer in that time period. This time period was chosen due to clinic protocol. Three weeks are given from first assessment to reassessment from progress.
- have completed their VRT treatments and had to have been discharged in that time period. This was used to allow for the length of time in therapy to be measured.
- have provided informed consent. This aspect is essential to ensure the ethics of the study.

Participants who were excluded in this study specifically did not meet with the following requirements:

- data were incomplete or missing.
- the participant decided not to be included in the study.

2.5.3: The records

From January 2010 to December 2013, 262 VNGs were conducted in the clinic used for this research. Of these 262 VNGs, 181 were referred for VRT. Due to clinic policy, participants' vestibular therapy records could only be viewed once informed consent was obtained from the participant. Once contacted, and informed consent had been obtained, 160 participants files were able to be accessed. Twenty-one participant files were not included. Reasons for them not being included were: Nine possible participants chose not to participate, five possible participants' contact details had changed and could not be contacted, four possible participants were underage, and two possible participants lived outside of South Africa and could not be contacted. Of the 160 possible participant files which could be accessed, 94 attended VRT. Of those 94 patients, 85 were acceptable for this research purpose. Six possible participants were excluded due to incomplete data and three possible participants were excluded as their files were missing. Twenty percent of the participants

were obtained from 2010. Sixteen percent of participants were obtained from 2011. Thirty-two percent of participants were obtained from 2012. Thirty-two percent of participants were obtained from 2013.

Eight-five participants is a relatively small sample for a retrospective study. Ideally, in retrospective research, a large sample size is recommended as it then yields more significant statistical results (Kumar, 2011). However, relative to the total number of dizzy patients seen in the clinic over the past four years, it represents a fair section of that population. Specifically, 262 patients were seen for assessments, thus the 85 participants represent 32.44% of that population. When looking at those who had an assessment and underwent vestibular therapy (94), 85 represent 87.23% of that population. While working with the dizzy population, and people in general, finding participants who fit the inclusion criteria as well as complete the full time period of the vestibular therapy is challenging. Much of the research conducted in dizziness has had fewer than 85 participants due to these factors (Zingler et al. 2008; Bamiou et al., 2000; Meli et al., 2006; Kao et al. 2010). Much of this research has been prospective and were contacted directly. These researchers investigated outcomes as well as other variables related to dizziness.

2.6: Test protocol

2.6.1: Material and apparatus

- Letter of informed consent (Appendix A).
- All participant files, where consent was provided and who met the inclusion/exclusion criteria, from January 2010 to December 2013.

2.6.2: Procedures

Prior to the study being conducted, ethical approval was obtained from University of the Witwatersrand Human Ethics Research Committee (Medical) (Appendix B). A proposal of the study was then submitted and accepted by the Faculty of Humanities postgraduate office (Appendix C). After each VNG the audiologist notes the diagnosis or diagnoses and what the recommendations were. The participants who had been seen for a VNG and were referred for VRT were then identified through this list. Participants were contacted and permission to access their clinic files was provided telephonically and then through an informed consent form which was signed by each participant. Informed consent forms (Appendix A) were written in the English, and if needed could be translated into the participant's home language. However, this translation was not needed as the participants were all conversant and literate in English. Consent forms were then emailed, faxed, posted or hand delivered to each participant. The signed consent form was then scanned and emailed, faxed, posted or hand delivered back to the researcher. Once access to the files was provided, the files corresponding to patients who were referred for and attended VRT were identified. The files of the participants who had attended VRT were analysed to determine if they met the inclusion/exclusion criteria. Of those that were appropriate for this research the following was documented into tables:

- Age.
- The presence of fluctuating dysfunction.
- The presence of migraines.
- Gender.
- Unilateral or bilateral peripheral vestibular pathology.
- The degree of peripheral vestibular asymmetry.

- The length of time from onset of symptoms to the onset of vestibular rehabilitation.
- The ABC score.
- ABC level of functioning (low, medium or high).
- The presence of diabetes.
- The presence of anxiety.
- The presence of neck stiffness.
- The presence of central signs.
- The presence of circulatory of vascular problems.
- The presence of osteoporosis and/or arthritis.
- The presence of epilepsy and/or seizures.
- The presence of thyroid problems.
- Multiple comorbid pathologies the patient presented with based on the above list.
- The lateralisation of peripheral vestibular pathology.
- Whether the participant had a single diagnosis or multiple diagnoses for their dizziness.
- The subjective level of dizziness at assessment
- The subjective level of dizziness at three-week mark

From the case history form and questionnaire the following information was obtained: age, the presence of fluctuating dysfunction, the presence of migraines, gender, length of time from onset of symptoms to onset of vestibular rehabilitation, the presence of diabetes, the presence of anxiety, the presence of neck stiffness, the presence of circulatory or vascular problems, the presence of osteoporosis and/or arthritis, the presence of epilepsy and/or seizures, the presence of thyroid problems, and the presence of multiple comorbid pathologies. Based on the caloric measurements the degree of peripheral vestibular

pathology was determined. Caloric response differences when comparing the right and left peripheral vestibular response of greater than 20%, was considered a significant difference and peripheral vestibular pathology was diagnosed. From this caloric calculation the lateralisation of peripheral vestibular pathology was also documented. If caloric responses were asymmetrical, then unilateral vestibular pathology was diagnosed. If caloric responses were less than ten deg/sec bilateral peripheral vestibular pathology was diagnosed. This was also documents. The ABC score was obtained from the ABC objective questionnaire completed by the participant. The researcher took this score and compared it to Powell and Myers (1995) level of functioning based on the ABC score and documented whether the participant had a low, medium or high level of functioning. The presence of central signs was determined though abnormal ocular motor tests and/or presence of vertical nystagmus in gaze tests. The presence of multiple versus single diagnoses was determined through the audiologist's conclusions. Lastly subjective levels of dizziness were documented in the physiotherapist's therapy notes.

The data tables were then interpreted using the data analysis described below.

2.6.3 Description of the participants

Of the 85 files that fitted the inclusion criteria and were accepted for this study, 20% were obtained from 2010, 16% were obtained from 2011, 32% were obtained from 2012 and 32% were obtained from 2013.

Thirty-nine percent (33 participants) of participants were male, and 61% of participants (52 participants) were female. Ages ranged from 18 to 83 years old, with a mean age of 51.94 years old, and a standard deviation (SD) of 17.41. Figure 1 below depicts the age of participants in ten year intervals.

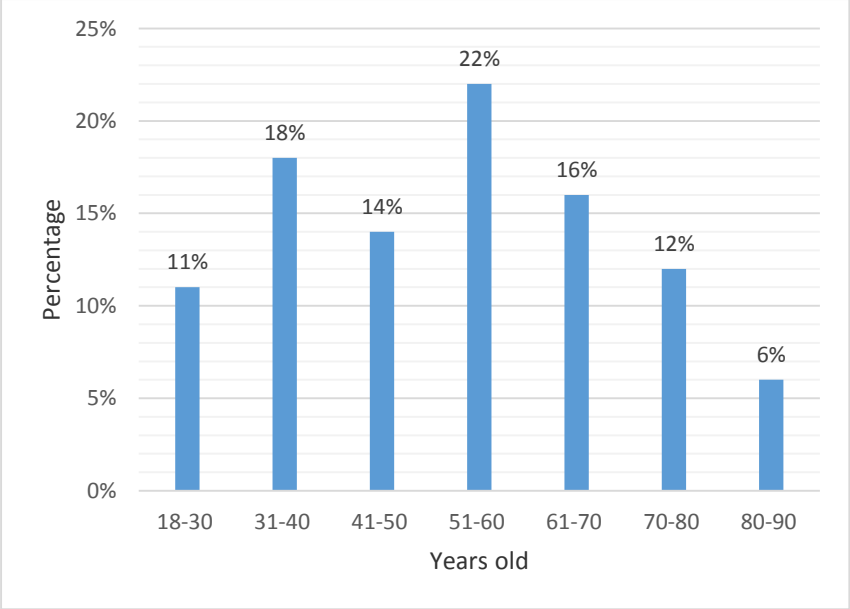


Figure 1. Age in years

When taking into account all caloric measurements, 54% of patients had left sided peripheral vestibular pathology, while 46% had right sided peripheral vestibular pathology.

2.6.4 Ethical Considerations

- Ethical clearance was obtained from the University of the Witwatersrand Human Ethics Research Committee (Medical) (clearance certificate number: M131111 (Appendix B).
- All participants provided informed consent that their records could be used in the research. As previously mentioned, this consent was obtained via an emailed, faxed, posted or hand-delivered consent form. Informed consent needed to be obtained to ensure protection of human rights. The principle that underlies consent is that the participant must have enough information about the investigator and the research to form the basis for reasonable trust (Kimmel, 1988). All the consent forms, distributed to participants who agreed telephonically to participate in the research, were completed and returned to the researcher.

- Assurance of privacy and confidentiality were provided to the participant. This assurance referred to an agreement between the participants and researcher that limits anyone else access to private information (Kimmel, 1988). A research participant agrees to allow a researcher access to their personal information in their files, but only under the circumstance that a researcher agreed to limit access by others to data that can be linked to the participant (Kimmel, 1988). Participants in this study were informed that raw data will be kept for two years following any publication or for six years if no publications emerge from the study.
- The participants were informed that they were under no obligation to remain part of the research and could withdraw at any time. No participant chose to withdraw.
- The benefits and risks to participants were none, as with retrospective record reviews participants have no contact with researchers and play no active role in the research.
- The participants included in this research were not considered a vulnerable group.
- Anonymity and confidentiality of each participant record was ensured through the use of the participant's initials being used when referring to them, all fact sheets were kept separate from the data collected, and only the researcher was given access to the identifiable information.

2.7: Data analysis and statistical procedures

This section will first split into single analysis of variables and then combination analysis of variables. The variables were a blend of nominal and interval variables, while the outcome variables were ordinal. Firstly the outcome variable of "improved", "stayed the same" or "got worse" was used. This was later changed to "improved" and "not improved", to allow for more participants falling under each category.

The original model for analysis of the data was a multinomial logistic regression model. Multiple regressions are used to predict a criterion variable based on several predictive variables simultaneously (Howell, 2002). The outcome variable (or dependent variable) was ordinal. Specifically, at first three outcomes were used: level of dizziness "improved", level of dizziness "stayed the same", or level of dizziness "got worse". This was modified later to two outcomes: level of dizziness "improved" or level of dizziness "not improved"; as this allowed for a greater number of participants to be in each group. The independent variables were a mix of nominal and interval variables.

As per the literature reviewed the following nominal variables were included: gender, unilateral versus bilateral peripheral vestibular weakness, the comorbid pathologies, the degree of functioning according to the ABC score, the lateralisation of peripheral vestibular pathology, and multiple comorbidities that were present.

As per the literature reviewed the following interval variables were included: age, degree of peripheral vestibular weakness, and the length of time from the onset of symptoms to the onset of VRT. The data obtained from the record review were tabulated using the categories previously set out by the researcher.

Due to the smaller than expected numbers of participants in each variable, single relationships were firstly considered. To consider relationships of ordinal variables versus nominal variables, a Chi-square test was used. When considering relationships between ordinal variables versus interval variables, Spearman's correlation was used. Chi-square tests are used to determine whether association or dependence exists between various characteristics (Eysenck, 2008), while Spearman's correlation is applied when data occurs in ranks as opposed to raw scores (Howell, 2002).

With the smaller than expected number of records, analysis of combinations of characteristics was difficult. Therefore to investigate the effect that combinations of

characteristics have on the outcomes of therapy, decision trees were used. A decision tree models allowed for the development of a classification system that predicted future outcomes based on a set of decision rules (Linoff & Berry, 2011). The value of the decision tree is that it accounts for the interaction between the independent variables, and allows for the building a model with a lot of independent variables. The decision tree consists of nodes where logical decisions are made, and connecting branches are chosen according to the result of that decision (Linoff & Berry, 2011). The nodes and branches that are followed establish a path through a decision tree that reaches a final decision in the end. Each node represents an independent variable in the dataset (Linoff & Berry, 2011). The root node of a decision tree is the first decision node. Each node in a tree contains some data. The decision was made to split the node into branches on the basis of an algorithm (Linoff & Berry, 2011). To create the first split the most important independent variable was used. The process was repeated until a complete tree was obtained (Linoff & Berry, 2011). When the node could not be split further it was the final decision node. Stopping rules were also used to ensure the tree was not too large, with nodes that are not useful (Linoff & Berry, 2011).

2.8: Reliability and validity

Reliability and validity are the two key elements that ensure that the research provides consistent results and that the research actually measures what it claims to be measuring (Black, 2005). Reliability ensures that the results are consistent and do not differ over time, place or subjects. Validity talks to the extent to which the concepts play to the real world (Black 2005).

2.8.1: Threats to reliability and validity

- Due to the clinic policy that vestibular therapy files may only be accessed once participant consent was obtained, the exact number of possible participants could not be determined prior to the proposal for the study being developed. One hundred and eighty one participants were referred for VRT, while only 94 went for VRT. Therefore once informed consent was obtained, and the predicted number of participants was significantly less than what was proposed, and the statistical analysis of combination of variable had to be amended. On the other side to this difficulty experienced, as mentioned earlier, and is seen in this and previous studies, the population of dizzy patients presenting with the exact inclusion criteria for a specific study is fairly small and therefore this number is still thought to be representative of the real world (Bamiou et al., 2000; Kao et al., 2010; Meli et al., 2006; Zingler et al., 2008;).
- Retrospective research always runs a risk of incomplete or inaccurate records (Drummond, 1996). This impacts on the reliability and validity of the research. Six files were excluded due to incomplete records or completely missing files. Five files could not be included due to contact details not being updated; therefore informed consent could not be obtained. This reduced the number of records available for this study
- If large numbers of participants refused to participate in the research, that would have affected the reliability and validity of the research. A small sample size prevents the ability of the research to illustrate a significant level or trait that may be identified (Drummond, 1996). Nine participants chose not to participate. Numbers were therefore slightly influenced.

- As is seen in many rating scales, not all patients understand the instructions completely, or do not answer seriously (Powell & Myers, 1995). This should be considered when looking at the answers to the ABC, and would affect the reliability and validity of the data obtained. The ABC makes use of a rating scale from zero to 100. The participant was required to rate how confident they are while performing the tasks presented in the form. Zero would be no confidence, while 100 would be complete confidence. According to a readability test the ABC is at a grade 3.95 level of reading (Online-Utility.org, n.d.). This indicates that a participant needed 3.95 years of education in order to understand the ABC instructions. The population that was included in this study had a level of reading higher than grade 4 as all had secondary level of education. They would therefore be able to understand the questions presented to them. Reliability and validity was maintained in this regard. There is no way to ensure that the participants took the rating scale seriously, however if the scale was incomplete the patient was excluded.

2.8.2: Implementations to ensure the reliability and validity of the research study

- Strict inclusion and exclusion criteria, as described above, were implemented when choosing the records to include in the study.
- Incomplete and inaccurate records were excluded from the study.
- The data were analysed objectively so that if an independent party analysed the data they would draw the same conclusions**.** This was conducted through the researcher ensuring that all information used within the research was taken exactly as it was presented in the records. No information was changed.
- The conclusions drawn from the data are supported by established theoretical rationalisations in the literature. If literature is not available in a specific area, the

results are described according to the best available information at the time of the research interpretation.

Chapter 3: Results

This chapter presents the results that emanated from the analysis presented in the methodology. As discussed, data were obtained by tabulating all the information from participants who attended vestibular assessment and rehabilitation from January 2010 until December 2013 into raw data tables. Distribution information is presented first. This is followed by single analysis between single variables and the therapy outcomes, presented in tabulated form based on the sub-aims, with the summary of significant findings following this. As previously mentioned, therapy outcomes were first divided into three areas; namely "improved", "stayed the same" and "got worse". Therapy outcomes were then changed to two areas, "improved" and "not improved", to allow for more participants to fall under each category. Following the analysis of single variables, combinations were tested using decision trees. These are presented in summary paragraphs with patient profiles in listed and tabulated form.

3.1: Distribution information

Based on caloric responses, the percentage of peripheral vestibular pathology ranged from 0-100% damage, with a mean of 27.98% damage, and SD of 24.18. Figure 2 below shows the distribution of degree of peripheral vestibular pathology based on these caloric measurements. Twenty-one percent of participants were diagnosed with no significant peripheral vestibular asymmetry, 62% were diagnosed with unilateral peripheral vestibular pathology and 16% were diagnosed with bilateral peripheral vestibular pathology.

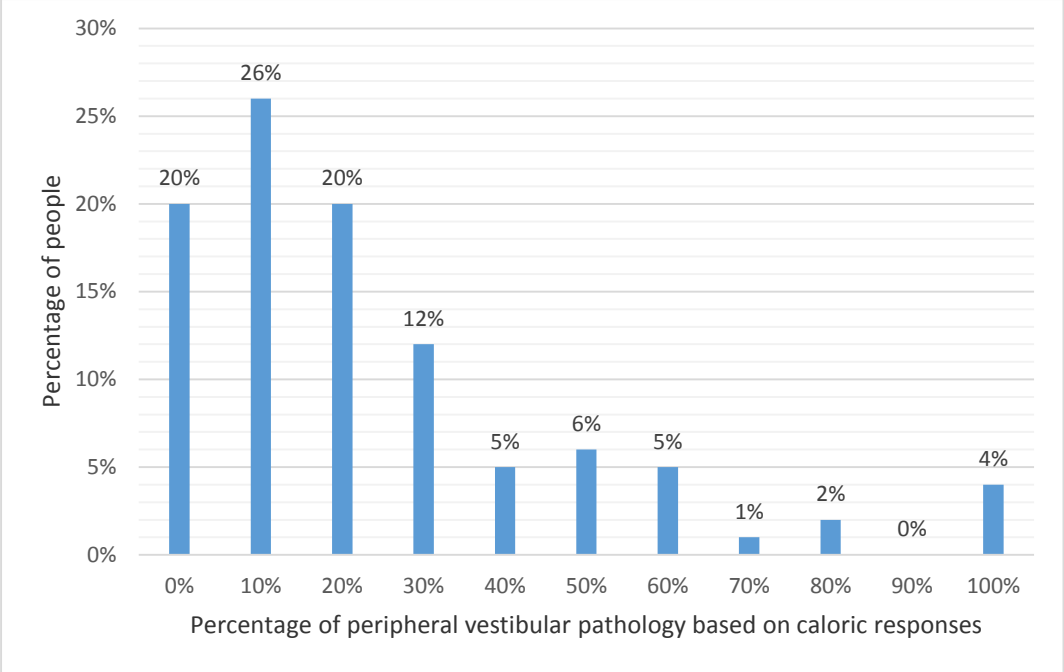


Figure 2. Percentage of peripheral vestibular pathology based on caloric measurements

Of the 85 patient records, 44% of patients were diagnosed with single causes for their dizziness, while 55% were diagnosed with multiple causes for their dizziness.

When looking specifically at the comorbid pathologies, some patients presented with multiple comorbid pathologies. Participants ranged from having zero (9%; n=10) to having seven (1%; n=1), with the majority of people having two comorbid pathologies (33%; n=28). This distribution is depicted in Figure 3 below. Eighteen percent of patients experienced fluctuating dysfunction (n=15), 12% presented with migraines (n=10), 5% of patients were diagnosed with diabetes (n=4), 47% of patients reported some anxiety (n=40), 55% of patients reported neck stiffness (n=47), 44% of patients presented with central signs (n=37), 13% reported circulatory or vascular difficulties (n=11), 18% reported osteoporosis and/or arthritis (n=15), >1% was diagnosed with epilepsy (n=1), and 11% were diagnosed with a thyroid problem (n=9).

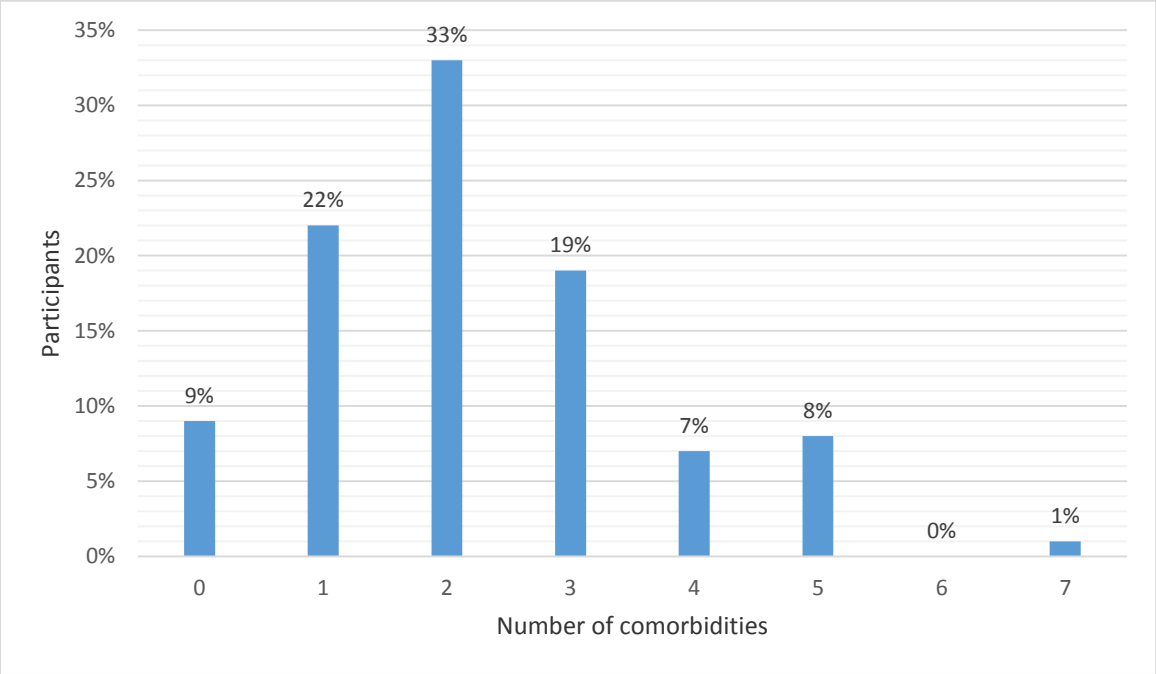


Figure 3. Number of comorbidities

Scores for the ABC ranged from 7.5-100% balance confidence, with a mean of 71.69% balance confidence, and SD of 20.85. Based on the classification system set out by Myers et al. (1998), eleven percent were classified with low levels of functioning. Fifty-eight percent were classified with moderate level of functioning. Forty-five percent were classified with high level of functioning. The ABC scores are presented in Figure 4 below.

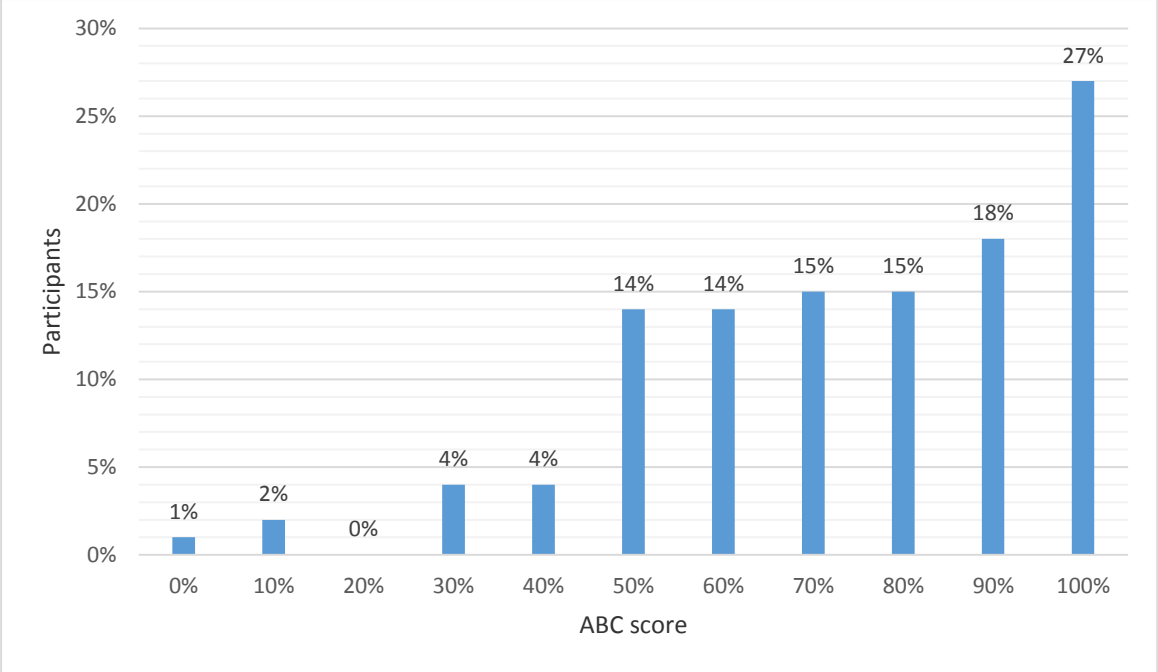


Figure 4. ABC score

The length of time from the onset of the patient's symptoms to the vestibular assessment ranged from less than a month to 240 months (20 years). Sixty-nine percent of participants took less than 25 months (2.1 years) to attend vestibular therapy, with a mean of 39 months (3.25 years), and SD of 58.78. The length of time spent in therapy ranged from three weeks to more than a year. The mean length of time in therapy worked out to be 14.23 weeks, with an SD of 30.1.

As reflected in Figure 5 below, the patients' subjective level of dizziness at the physiotherapy assessment ranged from 0-5, with a mean of 2.03, and SD of 1.17. The patients' subjective levels of dizziness at the physiotherapy three week follow-up, ranged from a subjective dizziness of 0-5, with a mean of one, and SD of 1.3. This distribution is shown in Figure 6 below. Forty-six percent of patients reported improvement at their three week follow-up. Thirty-six percent of patients reported no change to their dizziness. Eighteen percent of patients reported their dizziness to be worse at their three week follow-

up. When the dependent variable was modified to "improved" and "not improved", 46% of patient's dizziness improved, while 54% of patient's dizziness did not improve.

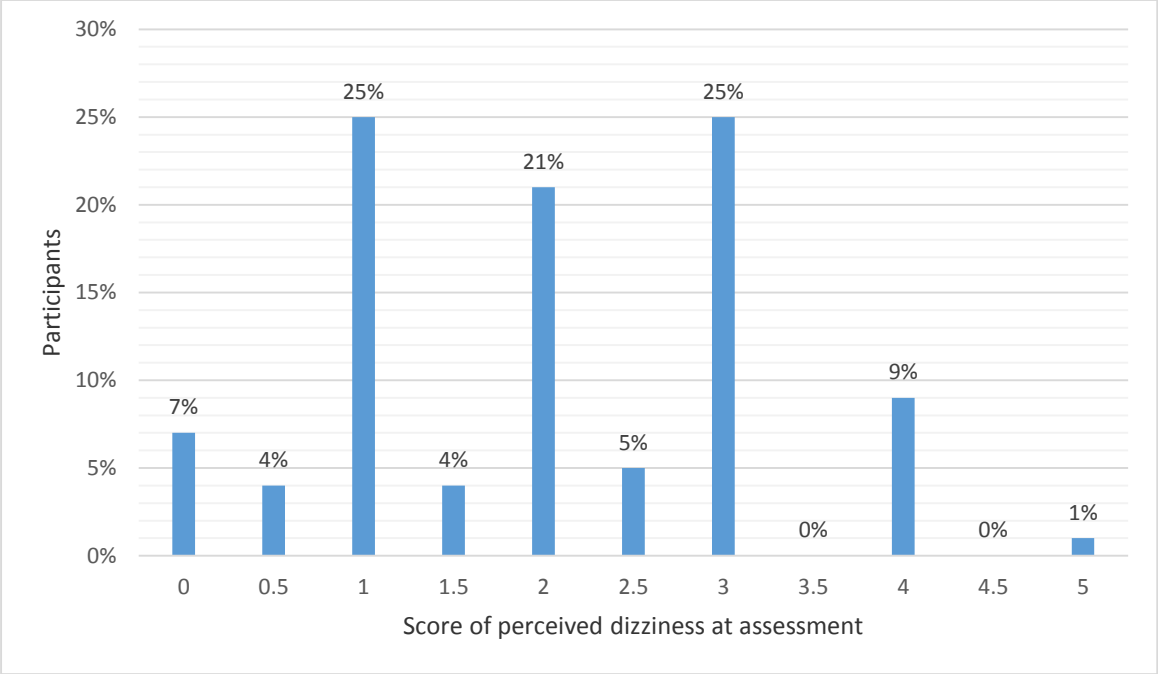


Figure 5. Score of perceived dizziness at assessment

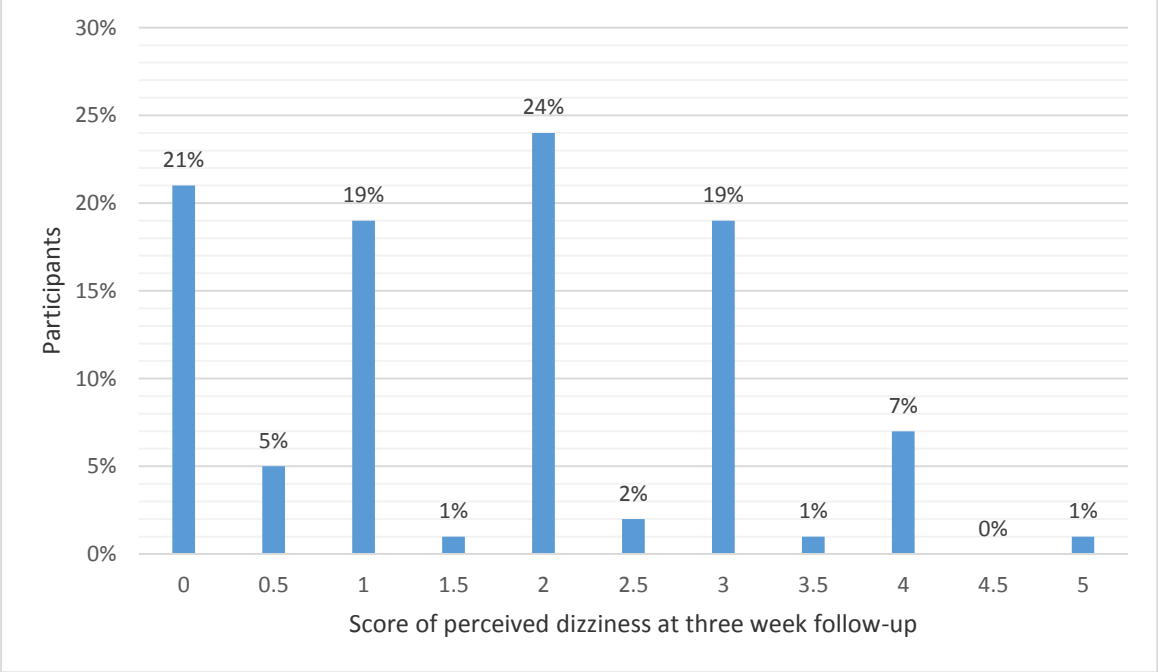


Figure 6. Score of perceived dizziness at three week follow-up

3.2: Results from single analysis between single variables and therapy outcomes

To analyse the relationship between single patient characteristics, depending on the type of variable, either Chi-square or Spearman correlation was used. In Chi-square tests, to determine if a statistically significant association between variables is present, a probability value (p-value) was produced. It is considered statistically significant if the p-value is smaller than 0.05. In Spearman correlation, if the correlation coefficient is near to +1, the variables are highly positively correlated. If the correlation coefficient is near to -1 the variables are highly negatively correlated. When the correlation coefficient is near 0, no correlation exists at all.

3.2.1: Results from single analysis between single variables and three therapy outcomes; namely “improved”, “stayed the same” and “got worse”

Table 1 below depicts the single analysis between single variables and three therapy outcomes, specifically did the patient improve, did the patient stay the same or did the patient get worse, based on their self-perceived levels of dizziness. Two data analysis methods were used namely Chi-square tests and Spearman correlation.

Table 1

Summary of individual analysis with the dependant variable having three outcomes ("improved", "stayed the same" and "got worse")

Independent variables/characteristics:	Test	DF	Statistic	P-value	Significance
Fluctuating dysfunction	Chi-square	2	11,5	0,0032	99% - highly significant
The presence of migraines	Chi-square	2	0,21	0,9014	None
Gender	Chi-square	2	3,05	0,2177	None
Unilateral or bilateral peripheral vestibular pathology	Chi-square	4	2,628	0,6219	None
The presence of diabetes	Chi-square	2	0,97	0,6166	None
The presence of anxiety	Chi-square	2	5,36	0,0686	None
The presence of neck stiffness	Chi-square	2	0,17	0,9185	None
The presence of central signs	Chi-square	2	1,81	0,4049	None
The presence of circulatory or vascular problems	Chi-square	2	0,5	0,7781	None
The presence of osteoporosis and/or arthritis	Chi-square	2	3,16	0,2063	None
The presence of epilepsy	Chi-square	2	1,19	0,5506	None
The presence of thyroid problems	Chi-square	2	1,97	0,3737	None
ABC degrees of functioning (low, moderate or high)	Chi-square	4	6,927	0,1398	None

Table 1 continued

Independent variables/characteristics	Test	DF	Statistic	P-value	Significance
Lateralisation of peripheral vestibular pathology	Chi-square	2	1,86	0,3955	None
Single or multiple diagnoses (unknown removed)	Chi-square	2	4.67	0.0967	90% possible significance
Multiple comorbidities	Chi-square	12	19,94	0,0683	90% possible significance
Age	Spearman correlation		r=-0.0.170	0,877	None
Degree of peripheral vestibular pathology	Spearman correlation		r=-0.107	0,3296	None
Length of time from onset of symptoms to onset of VRT	Spearman correlation		r=-0.0123	0,8463	None
ABC score	Spearman correlation		r=0.1623	0,1378	None

As reflected in Table 1 above, no statistical significant p-values were identified except in the case of fluctuating dysfunction. In the case of fluctuating dysfunction a p-value of 0.0032 was obtained. This is less than 0.05, therefore an association exists between therapy outcomes and fluctuating dysfunction. In this particular case the p-value is smaller than 0.01, indicating a significant association between therapy outcomes and fluctuating dysfunction, at a 99% level of confidence. When looking at therapy outcomes and multiple comorbid pathologies, as well as the presence of multiple diagnoses or a single diagnosis for dizziness, a p-value of less than 0.1 were found. This was not significant, however was close to significant, at a 90% level. No other significance was identified using Chi-square tests.

When analysing the data using the Spearman correlation, all variables analysed revealed no correlation.

3.2.2: Results from single analysis between single variables and two therapy outcomes, namely "improved" and "not improved"

In order to analyse with better accuracy whether trends exist and to allow for variables to include more participants, the therapy outcomes (dependent variable) were changed from "improved", "stayed the same" or "got worse"; to "improved or "not improved". The "stayed the same" and "got worse" categories were added together. The independent variables did not change. Spearman correlation could not be conducted as results are less significant with only two dependent variables. More than two variables as well as variables that occur on a continuum are required to use the Spearman correlation. Therefore age, degree of peripheral vestibular pathology, length of time from onset of symptoms to onset of VRT, and ABC score', as a continuum, could not be analysed with this new dependent variable. The summary of the results obtained are reflected in Table 2 below.

Table 2

Summary of individual analysis with the dependant variable having two outcomes ("improved" and "not improved")

Independent variables/characteristics:	Test	DF	Statistic	P-value	Significance
Fluctuating dysfunction	Chi-square	1	0.25	0.6144	None
The presence of migraines	Chi-square	1	0.08	0.7809	None
Gender	Chi-square	1	2.97	0.0848	90% possible significance
Unilateral or bilateral peripheral vestibular pathology	Chi-square	2	0.35	0.8393	None
The presence of diabetes	Chi-square	1	0.03	0.8656	None
The presence of anxiety	Chi-square	1	2.14	0.1437	None
The presence of neck stiffness	Chi-square	1	0.06	0.8047	None
The presence of central pathology	Chi-square	1	1.71	0.1913	None
The presence of circulatory of vascular problems	Chi-square	1	0.38	0.5366	None
The presence of osteoporosis and/or arthritis	Chi-square	1	0.25	0.6144	None
The presence of epilepsy	Chi-square	1	1.19	0.2746	None
The presence of thyroid problems	Chi-square	1	0.008	0.9271	None
ABC degrees of functioning (low, moderate or high)	Chi-square	2	6.23	0.0443	95% significant

Table 2 continued

Independent variables/characteristics:	Test	DF	Statistic	P-value	Significance
Lateralisation of peripheral vestibular pathology	Chi-square	1	0.24	0.6227	None
Single or multiple diagnoses (unknown removed)	Chi-square	1	2.08	0.1493	None
Multiple comorbidities	Chi-square	6	5.64	0.4650	None

As reflected above in Table 2, the ABC degree of functioning obtained a p-value of 0.0443. This is less than 0.05, therefore a significant association exists between therapy outcomes and ABC degree of functioning, at a 95% level of confidence. When looking at therapy outcomes and gender, a p-value of less than 0.1 was found. This was not significant, however was close to significant, at a 90% level of confidence.

3.3: Results from combinations of variables, using the decision tree model

To investigate the effect that combinations of characteristics have on the outcomes of therapy, decision trees were used. In a decision tree logical decisions are made, and connecting branches are chosen according to the result of that decision (Linoff & Berry, 2011). The decision tree establishes a path that reaches a final decision in the end (Linoff & Berry, 2011). The decision tree yields a profile, where for the outcome to occur all aspects of the profile need to be present. When all the variables and combinations were tested, only the following profiles showed a relationship:

3.3.1: Results from the decision tree model with three therapy outcomes; namely "improved", "stayed the same" and "got worse"

As can be seen in Table 3, out of all the combination of variables, the variables that had the largest contribution, in order of importance were:

- Fluctuating dysfunction
- ABC score
- Laterality of peripheral vestibular pathology
- Gender

The stopping rule identified that the tree should not split to more than three levels. As discussed earlier, stopping rules are used to ensure over-fitting cannot occur (Linoff & Berry, 2011).

Participants that improved most were participants with:

- No fluctuating dysfunction,
- an ABC score greater than or equal to 43.75%, and
- male

The percentage of respondents in this group is 58.62% for improved versus the overall percentage of 45.88% (n=39/N=85).

Participants whose condition worsened most were participants with:

- Fluctuating dysfunction, and
- peripheral vestibular pathology in their right ear

The percentage of respondents in this group is 75% for improved versus the overall percentage of 17.65 % (n=15/N=85).

These findings are presented in Table 3 below.

Table 3

Summary of decision tree profile (three therapy outcomes)

Participants that improved:	Participants whose condition got worse:
• No fluctuating dysfunction, • an ABC score greater than or equal to 43.75%, and • male.	• Fluctuating dysfunction, and • peripheral vestibular pathology in their right ear.

3.3.2: Results from the decision tree model with two therapy outcomes, namely "improved" and "not improved"

As can be seen in Table 4 below, when the outcome was changed to improved and not improved, out of all the combination of variables, the variables that had the largest contribution, in order of importance were:

- ABC score
- Age
- Central signs
- The presence of anxiety

The stopping rule identified that the tree should not split to more than four levels. As discussed earlier, stopping rules are used to ensure over-fitting cannot occur (Linoff & Berry, 2011).

Participants that improved most were participants with:

- An ABC score greater than or equal to 43.75%,
- the presence of anxiety,
- no central signs, and
- 50 years old or older.

The percentage of respondents in this group is 81.82% for improved versus the overall percentage of 45.88% (n=39/N=85).

Participants that condition did not improve the most were participants with:

- An ABC score greater than or equal to 43.75%,
- the presence of anxiety, and
- central signs.

The percentage of respondents in this group is 78.57% for participants who did not improve versus the overall percentage of 54.12% (n=46/N=85).

Another profile that was revealed for participants that condition did not improve the most were participants with:

- An ABC score smaller than 43.75%.

The percentage of respondents in this group is 75% for participants who did not improve versus the overall percentage of 54.12% (*n*=46/*N*=85).

A summary of these findings can be seen in Table 4 below.

Table 4

Summary of decision tree profile (two therapy outcomes)

Participants that improved:	Participants that did not improve:
• An ABC score greater than or equal to 43.75%, • the presence of anxiety, • no central signs, and • 50 years old or older.	• An ABC score greater than or equal to 43.75%, • the presence of anxiety, and • central signs.
	• An ABC score smaller than 43.75%.

Chapter 4: Discussion

Vestibular therapy, when looking at the mean values of perceived dizziness, was shown to decrease the patients' perceived dizziness on average. Although the difference was not statistically significant, it is an exceptional advocator for vestibular rehabilitation for all qualifying patients, no matter the complexity of their presentation.

The influence of patient characteristics in isolation revealed, unlike other studies, a limited effect on vestibular therapy outcomes. Many of the characteristics which were hypothesised to influence vestibular therapy outcomes, based on the literature review of the study, made no impact on how the patient did in vestibular therapy. As shown in the results, fluctuating dysfunction and balance confidence were the only aspects which were found to influence vestibular therapy outcomes; both of which have already been identified as possible influences in previous research (Legters et al., 2005; Staab, 2011; Luxon, 2004; Powel & Myers, 1995; Shepard & Telian, 1995). Many other aspects were contrary to results of previous research, for instance the degree of peripheral vestibular pathology was found to have no influence on vestibular therapy outcomes (Bjerlemo et al., 2006; Kammerlind et al., 2005; Shepard & Telian, 1995). These unexpected results highlighted that people are complex and dynamic and need to be evaluated with a holistic approach. Looking at aspects in isolation, places all people in a limiting category, ignoring all other aspects and characteristics that may influence the therapy process. Looking at influences to therapy outcomes in combination allows for the patient to be treated as a whole, ultimately leading to better patient care (O'Brein, 2012).

4.1: Patient characteristics of non-significance.

Due to the findings of the literature reviewed, hypotheses were formed suggesting specific patient characteristics that would have a significant influence on vestibular therapy outcomes. While the above statement is true for fluctuating dysfunction and balance confidence; migraines, unilateral versus bilateral vestibular pathology, degree of peripheral vestibular pathology, length of time from onset of symptoms to onset of therapy, and the comorbid pathologies were found to have no significant influence on vestibular therapy outcomes when evaluated in isolation and in combination.

When looking into migraines and all the comorbid pathologies, all of these are widely considered to be a cause of dizziness on their own, either through the pathology itself or through the treatment of them (Alpini et al., 2014; Baloh & Honrubia, 2001; Bamiou et al., 2000; Erbayat Altay et al., 2005; Gawron et al., 2002; Hoffer et al., 2008; Oas, 2002; Sloan, 1989; Olshaker, 2010; Newman-Toker et al., 2008; Tusa, 2007). However, contrary to the hypotheses that were formed based on the above mentioned literature, the presence of any of these characteristics did not influence therapy outcomes when looked at in isolation and in combination with each other, as well as with all the other characteristics. As always, the downfall of retrospective research is the inability to document what is not in the files already. The severity of the above mentioned pathologies as well as how these were managed, could not be identified. It was noted throughout this study that further research into these areas, taking into account the severity and management of the pathologies, should be conducted.

Based on the literature reviewed, an aspect which appears to be a considerable influence on vestibular therapy outcomes was the degree of peripheral vestibular pathology. Much research agrees that the greater the degree of peripheral vestibular pathology, the more limited the success is in vestibular therapy (Bjerlemo et al., 2006; Kammerlind et al., 2005; Shepard & Telian, 1995). The current study has however found that a patient's perception of

progress in vestibular therapy is not influenced by their degree of peripheral vestibular pathology. This point is a great advocator for the ability of VRT to aid patients, from a mild to severe peripheral vestibular pathology. It should however be noted that the degree of peripheral vestibular pathology was measured solely based on caloric test findings. For this study vestibular evoked myogenic potentials (VEMPs) were not included.

Another characteristic which has been suggested to influence the outcome of vestibular therapy, is the time period before initiation of vestibular therapy. Research has suggested that delays in implementing vestibular therapy are associated with the development of chronic symptoms, and larger perceived disabilities (Bamiou et al., 1999; Hamid & Sismanis, 2006). However even with the majority of participants in the current study taking longer than two years before they sought help, no influence from this delayed period of time from onset of symptoms to onset of vestibular therapy was seen to negatively or positively influence their perceived progress in therapy. While the patient's symptoms are thought to often persist, owing to dizzy patients frequently avoiding movements which induce symptoms (Hamid & Samy, 2006; Strupp et al., 2001), research has found that only certain aspects are influenced; for example the incidence of anxiety, which according to previous studies increases with prolonged time periods before treatment is sought (Mendel et al., 1999). Other aspects, such as home management and recreation, were not influenced (Mendel et al., 1999). This again highlights the importance of looking at the patient as a whole.

There is little research on the reasons for the delay in initiation of vestibular rehabilitation, and this is an area which needs further investigation. Limited resources and limited access to healthcare are possible reasons in South Africa (Coovandia et al., 2009), as well as the lack of knowledge and expertise by physicians regarding what causes dizziness, the diagnostic tools, and what treatments are available (Derebery, 1999). This once more

highlights the need for further research into vestibular rehabilitation; because if there is more information on the benefits of vestibular rehabilitations as well as realistic time periods that patients would need to be in therapy, the private health care sectors would possibly cover the costs involved more effectively. As mentioned above, there is little information available with regards to the provision of services in the field of vestibular rehabilitation in South Africa and this should be researched further. More research into vestibular rehabilitation and the effectiveness of treatments will also lead to an improved knowledge base for physicians for possibly improved diagnosis and management of patients who experience dizziness.

A bilateral peripheral vestibular pathology has long been suggestive of a more severe pathology than a unilateral peripheral vestibular pathology (Brown et al., 2001). Damage to both peripheral vestibular systems as opposed to only one, is thought to influence the patient more severely and hinder the benefit of vestibular therapy (Brown et al., 2001). Contrary to the above mentioned literature reviewed and the associated hypotheses, in this study whether the patient had a unilateral or bilateral peripheral vestibular pathology had no influence on vestibular therapy. It is hypothesised that this difference possibly lies with the outcome measure. The most common symptom for bilateral peripheral vestibular pathology is severe imbalance (Petersen et al., 2013) and not necessarily dizziness, therefore as the outcome was measuring perceived dizziness, no difference was found. In support of the current study's findings, Gill-Body et al. (2000) found no difference between patients with bilateral and unilateral peripheral vestibular pathology when looking at perceived level of disability; however patients with bilateral peripheral vestibular pathology still had poorer measurable balance. This research study has found that whether the participant has unilateral or bilateral peripheral vestibular pathology, it makes no difference on their perception of change in perceived dizziness. It should be however again be mentioned that the symptoms

experienced by unilateral and bilateral peripheral vestibular pathology are different, as is often the vestibular rehabilitation process.

4.2: Patient characteristics of possible significance.

From this study it appears as though multi-disciplinarity and holistic approaches to patient care are themes which have been reflected strongly throughout. The fact that multiple comorbid pathologies and multiple diagnoses are possible influences on vestibular therapy, as well as combinations of variables are significant influences on vestibular therapy, all highlight the need to address all dimensions of the patient in therapy. Addressing the patient as a whole and then developing the appropriate team for management is imperative for proper patient care. If all aspects of the patient's needs, with regards to their dizziness, are not addressed the risk is patient mismanagement, which is, of course, ethically problematic.

In vestibular therapy the symptoms from the vestibular pathology are addressed, while the symptoms from the comorbid pathologies are often not. These comorbid pathologies, as discussed earlier, can often cause dizziness either through the pathology or through the medication used to treat it. This is also true for multiple diagnoses for the patient's dizziness, where the full cause of the dizziness is often not addressed. This research, in support of a previous study (Ardic et al., 2006), found that just over a third of the participants had multiple causes for their dizziness. This is a large portion of patients who require greater care than one clinician can provide. Although not all the same diagnoses were included in this research, the findings once again highlights the need for multi-disciplinarity in vestibular therapy.

Another theme which was highlighted in this study is the need for further research looking at combinations of characteristics which influence vestibular therapy. There is very little research on combinations of patient characteristics which influence vestibular therapy,

as well as comorbid pathologies and multiple diagnoses for dizziness. Research has been conducted on specific patient characteristics, specific comorbidities and a specific diagnosis. The influence of multiple characteristics is an area yet to be thoroughly investigated. As mentioned earlier, the risk is mismanagement of the patient and limited patient benefit.

4.3: Patient characteristics of significance.

There is very little research into combination/s of variables that would influence therapy outcomes. Literature reviewed suggests that this is a new area and unique profiles were identified. From the literature reviewed, many aspects were expected to come through as significant with regard to influencing vestibular therapy outcomes; however many did not. Based on the literature reviewed it was hypothesised that the majority of the characteristics included in this study would influence vestibular therapy, with the exception of gender and lateralisation of the peripheral vestibular pathology. However contrary to the literature reviewed and hypotheses formed, the majority of the findings in this study showed no influence when looked at in isolation. This suggests the need to look at the patient as a whole, and the need to bring in combinations of elements in research and the therapy plan. Within this study two main combination profiles were found to be of significant influence to vestibular therapy. The two combination profiles which were identified were comprised of characteristics that were expected to be significant influences (fluctuating dysfunction and balance confidence), as well as characteristics which were uniquely found to be of an influence (lateralisation of the pathology). This study also identified aspects which were expected influencers such as anxiety, however the influence which occurred was opposite to what previous research has found. In the case of anxiety, when people are anxious it was also found to be of a positive influence to vestibular therapy outcomes under certain circumstances. Due to the nature of profiles yielded from decision trees, this occurs

specifically when the patient is 50 years old or older, has a higher ABC score and shows no central signs.

4.3.1: The first profile

The first profile highlighted four characteristics; fluctuating dysfunction, balance confidence, gender, and lateralisation of pathology; as having an influence on vestibular therapy outcomes, when they were found in combination with one another. Of the four characteristics, fluctuating dysfunction and balance confidence, based on the results of the analysis in isolation and the literature reviewed, were expected to influence vestibular therapy in combination. Gender and lateralisation of pathology were however unexpected characteristics that influenced vestibular therapy outcomes.

Looking closer into fluctuating dysfunction in vestibular pathologies; fluctuating dysfunction is reported to be one of the most common symptoms reported, due to the presence of Ménière's disease being one of the most common causes of peripheral vestibular pathology (Kroenke et al., 2000). The current study, in support of previous research efforts, agrees that the presence of fluctuating dysfunction has a negative effect on vestibular therapy outcomes (Luxon, 2004; Shepard & Telian, 1995). This aspect on its own appeared to cause patients who attend vestibular rehabilitation to do worse after three weeks in therapy. As expected, fluctuating dysfunction was also found to be a significant influencer with the combination analysis. When fluctuating dysfunction was present, the patient did worse; when fluctuating dysfunction was absent the patient improved. The debate among researchers does not seem to lie in whether fluctuating dysfunction influences patients in vestibular rehabilitation, but rather whether patients with fluctuating dysfunction should attend vestibular therapy at all. Luxon (2004) strongly suggests that patients should wait until the dysfunction has stabilised. It appears that no research has been conducted

comparing patients with fluctuating dysfunction that attend vestibular rehabilitation, and those with fluctuating dysfunction that don't attend vestibular rehabilitation. Further research is needed.

Balance confidence, as mentioned above, is a known contributor to vestibular therapy outcomes, specifically low balance confidence. Interestingly, within the current study, it was found that low balance confidence did not necessarily cause patients to do worse, however it is more likely to cause patients to not improve. Based on previous research this is supported, and has been hypothesised that their low confidence may cause less carry-over into their home environment, therefore compensation takes longer (Legters et al., 2005; Staab, 2011; Strupp et al., 2001; Whitney et al., 2004). Specific highlights have been placed on low balance confidence and its negative effect on the patient's performance within vestibular therapy (Legters et al., 2005; Strupp et al., 2001). Low balance confidence is a significant influence on vestibular therapy and should be measured and addressed in order for therapy to move forward, and success to be found.

Balance confidence is a subjective measurement, which cannot be measured through the objective tests conducted to diagnose the patient (Herdman as cited in Meli et al., 2006). The ABC is a known, successful measure of a patient's subjective confidence in their balance (Botner et al., 2005; Jarlsater & Mattson, 2003; Powell & Myers, 1995), and was the measurement used in this study. It appears, when looking at a patient's subjective assessments, when they are subjectively not confident in their balance, they perceive their dizziness as not improving. This is an interesting aspect which highlights the importance of patient perception on therapy outcomes. This study confirmed what Whitney et al. (2004) identified and highlighted in their research, suggesting that perception of balance confidence influences the level of disability the patient perceives they have.

Another interesting element which was revealed when looking into balance confidence, specifically the ABC, was that patients considered themselves to be not improving with a balance confidence of anything less than 43.75%. Powell and Myers (1995) found that patients are considered to have low levels of functioning with a score anything less than 50%. The current study suggests that clinicians should consider a slightly lower percentage level when considering their progress in vestibular therapy.

The other two characteristics which were unexpected influencers on vestibular therapy in the combination of characteristics, were gender and lateralisation of peripheral vestibular pathology. Both these aspects, when looked at in isolation, and as suggested by previous research, were not influences on vestibular therapy outcomes (Bamiou et al., 1999; Beidel & Horak, 2001; Shepard & Telian, 1995; Staab, 2011). Although contrary to much research suggesting that gender has no influence (Beidel & Horak, 2001; Shepard & Telian, 1995; Staab, 2011), when looked at in combination, this study found that gender had an influence on vestibular therapy. This is supported by some of the research presented above who suggest that males are more likely to improve in vestibular therapy than females (Hall et al., 2004; Vereeck et al., 2008). It is hypothesised that this may be due to strength more than gender, as females tend to have weaker muscles for balance control, than men (Vereeck et al., 2008). Another interesting aspect which came through in the research was the distribution of the gender being more swayed towards women. There is much research that supports this finding (Cheung et al., 2010; Kammerlind et al., 2005; McGibbon et al., 2005). The reason for this unequal distribution is unknown. Whether it is due to the fact that women are more susceptible to dizziness than men, or whether it is due to the fact that men are more likely to not seek help for their dizziness (Addis & Mahalik, 2003) is unknown.

In the area of lateralisation of peripheral vestibular pathology, the findings were unexpected due to the lack of research into the area. The right peripheral vestibular system

was found to be of influence in combination. This was contrary to what appears to be the only study that has included lateralisation as an aspect (Bamiou et al., 1999). Due to the limited research into this area, only hypotheses can be developed to explain these findings. One hypothesis is based on research by Tabak et al., (1997) which suggests that patients are more likely to fall towards their side of lesion, due to the deviated subjective visual vertigo. Perhaps then patients who have their right side of functioning impaired are likely to do worse. This finding was however only established in combination with fluctuating dysfunction. The second hypothesis therefore suggests that perhaps fluctuating dysfunction is more likely to occur in the right ear. This is based on research conducted by Bamiou et al. (1999) who found that total canal paresis is more likely to occur in the left ear. More research is needed in this area.

4.3.2: The second profile

The second profile highlighted balance confidence, anxiety, central sign, and age as significant characteristics. Once again, as based on previous research, hypotheses made from it and the analysis of characteristics in isolation, certain aspects were expected and certain aspects were unexpected. Central signs as a negative influence was an expected result. Balance confidence, although an expected influence was a significant trend and important predictor of therapy outcomes in this profile. Anxiety was found to play a double role, of a positive and negative influence on therapy outcomes, whilst increased age, to a degree, was found unexpectedly to be a positive influence.

An aspect which was unique to this profile was the influence of a higher balance confidence. Higher balance confidence, in certain combinations, did not necessarily mean patients would improve. When a patient had anxiety, no central signs, and were 50 years of age or older, they improved; however if they had good balance confidence, anxiety, and

central signs, they did not improve. As is often indicated in the holistic approach to patient care, patients should be looked at as a whole when developing therapy plans (O'Brein, 2012). It is therefore important to know which aspects are significant, and what combinations are particularly worse than others. Due to research suggesting that low balance confidence is associated with poorer outcomes in vestibular therapy (Legters et al., 2005; Staab, 2011; Strupp et al., 2001), it is fair to assume that higher balance confidence would lead to better vestibular therapy outcomes. This remains true when in combination with anxiety, no central signs and the patient being 50 years or older. Should the patient however have anxiety, and central signs, this no longer holds true.

Anxiety was another characteristic which was found as a positive influence and as a negative influence in the combination profiles. Anxiety is known to cause fear of falling, impaired motor control strategies (Agarwal et al., 2000; Baloh & Honrubia, 2001), and emotional distress (Eckhardt-Henn, Breuer, Thomalske, Hoffman & Hopf, 2003); therefore the presence of anxiety causing a negative influence on vestibular therapy outcomes was expected. With anxiety when found with central signs, even with good balance confidence, the patient does not improve. Interestingly when found with no central signs, patients older than 50 years, and good balance confidence were shown to improve. As mentioned, the presence of anxiety has been associated with poorer outcomes in therapy. Some research has however highlighted the importance of psychological support in vestibular rehabilitation (Mendel et al., 1999). It is hypothesised that the positive influence of anxiety, found in this combination profile, is perhaps due to the patients receiving the necessary psychological support. As a result of the patient indicating that they had anxiety, the therapist provided psychological support and the patient improved.

Looking again more closely at the negative impact of patients presenting with anxiety, central signs, and good balance confidence, research has shown central signs as a hindrance

to therapy due to the difficulty with central compensation, a process that needs to occur with vestibular therapy (Furman & Whitney, 2000; Konrad et al., 1992; Shepard et al., 1993). Research has found that often patients with associated central pathology need longer periods of rehabilitation (Furman & Whitney, 2000; Konrad et al., 1992; Shepard et al., 1993). On the contrary, in the individual analysis, central signs were found to be of no influence on vestibular therapy outcomes. Based on this analysis on its own, due to compensation occurring centrally, and compensation being imperative for vestibular therapy, it was expected to be a significant influence. It should, however, be noted that the research previously conducted on central pathology and vestibular therapy included patients with diagnosed central pathology. The current study used only the indicators within a VNG test, specifically abnormal ocular motor testing and/or vertical nystagmus on gaze testing, as central signs. It is hypothesised that perhaps the central sign indicators (ocular motor tests and the presence of vertical nystagmus on gaze testing) in VNG testing is too broad, and lend themselves to over-referral. On the other hand, the analysis in the combination profile suggests that considering central signs in therapy plans is exceptionally important and should not be overlooked.

Another interesting aspect which was evident in this profile was the aspect of patients 50 years or older as an indicator of patients who do better. Increasing age has long been thought to influence vestibular therapy in a negative way. It is thought that with increased age; vestibular, musculoskeletal and central systems degrade (Bergstrom, 1973; Kim et al., 2008; Richter, 1980; Rosenhall, 1973; Sekular & Hutman, 1980; Sturnieks et al., 2008); thereby causing more imbalance and dizziness, and hindering central compensation. Contrary to the above school of thought, in the current study, slightly increased age, of 50 years or older, influences vestibular therapy positively; when found in combination with good balance confidence, anxiety, and no central signs. Some studies have suggested that once

correction has been made for comorbidities and medications, the influence of age on vestibular therapy is limited (Ardic et al., 2006; Downton & Andrews, 1991; Hall et al., 2004; Kao et al., 2010; Tinetti et al., 2000). None of the above mentioned previous research has suggested that increasing age has a positive influence on vestibular therapy. This may be due to the fact that most previous research has not focused on a population younger than retirement age. Much of the abovementioned previous research has been focused more on the population of 65 years or older. Perhaps with increasing age, over 65 years, therapy outcomes would be affected more negatively. The age cut-off, of where increased age stops being a positive and begins to become a hindrance has not been researched as of yet, and should be considered. Due to the limited research of age being a positive influence, no hypotheses are available to draw from, for what could be the reason for this. It is possible that patients who are between the ages of 50 and 65 years are often in positions of higher responsibility and provision, than their counterparts. They are therefore possibly more motivated to return to these roles in their work and home environment.

The last significant aspect which was identified in these profiles was again the association of low balance confidence related to no improvement in vestibular therapy. This aspect required no other characteristics to be a negative influence on vestibular therapy. This highlights firstly how important confidence in balance is, as well as how important it is for a clinician to measure it in their therapy sessions. Low balance confidence has consistently come through as a trend when predicting a more negative vestibular therapy outcome, and has been discussed above. The measurement of balance confidence, specifically with the help of the ABC, is advocated in the current study as a very helpful tool in predicting therapy outcomes.

Chapter 5: Conclusion, strengths, limitations and implications

5.1: Conclusion

Fewer than expected patient characteristics were found to influence vestibular therapy. Significant characteristics that would influence vestibular therapy were however identified when looking at characteristics in combination. Throughout the current study the holistic approach to patient care in vestibular therapy was highlighted. Through this holistic view of patient care, the element of a multidisciplinary team approach to vestibular therapy was indicated. Another trend which was particularly relevant and a specific influence to results and therapy outcomes was the importance of patient perception in therapy. This was especially relevant when unexpected results were identified, suggesting that the patient's perception of success in therapy often would differ from the objective outcome measurements. This is highlighted in the significant trend which was found between perceived confidence in their balance and their perceived success in therapy. The current study specifically contributes to the field of management of dizzy patients by providing the clinician as well as policy makers, with the tools that are needed to provide better patient care. Looking at the whole patient allows for all influences to be taken into account and therefore addressed. With research into this area realistic time periods and resources can be provided and ultimately the patient is provided with better patient care.

5.2: Strengths and limitations

5.2.1: Strengths

- This study is a start at looking at patients holistically, taking into account the multiply characteristics that make up one person. Research into combinations of characteristics allows for patient specific interventions to be developed.

- The study highlights the need for personalised, patient specific vestibular therapy programmes.
- The study highlighted that information provided through research on other populations is not always applicable in the South African context.
- This researched showed the benefit of a multidisciplinary team approach to vestibular rehabilitation.
- The personal views of the patient are also shown to be of specific value and influence on vestibular rehabilitation, therefore highlighting the need to address this aspect.
- Information on the patient in the South African context was provided giving us more information as well as motivation into the need for further research.

5.2.2: Limitations

- Information obtained from this research can only be generalised to that specific setting in Johannesburg.
- Due to the strict inclusion and exclusion criteria needed for this kind of research, and poor patient compliance to therapy schedules, obtaining large numbers for research is difficult. This is seen in other research into dizziness and vestibular therapy, as mentioned above, and is perhaps why combinations of variables in research are rare. Due to the smaller numbers, in order for combinations of patient variables to be included, decision trees were used.
- As the definition of dizziness varies from patient to patient, the therapy outcome measurement may have been influenced by a patient's different definitions of dizziness. Thus the outcome measurement may differ depending on what the

patient's definition of dizziness is, however this is a known characteristic when looking into a patient's perspective.

- The measurement of degree of peripheral pathology was based solely on caloric testing findings, while future research should consider including VEMPs too.
- A three week window is a fairly short time period to look at, even though vestibular therapy is considered fairly short-term therapy. The current study showed that the average time period patients underwent vestibular therapy was 14.23 weeks. This may have been due to extreme outliers, however future research should consider including a longer time window.

5.3: Implications

The current study provides us with information on combination of patient characteristics that influence vestibular therapy. This allows the clinician to look at patients holistically, and provides some light on how different patient characteristics interact and influence one another. This will then ultimately allow for better patient care as clinicians, patients, and the policies in place with regard to vestibular therapy, are informed from a holistic perspective.

5.3.1: Implications for practice (the present clinician and training of future clinicians)

- More information is required on characteristics which may prolong therapy time periods, therefore allowing for the clinical practice, the clinician and the patient to make the necessary provisions.
- A clinician working with a patient who presents with fluctuating dysfunction should take into account that their patients do worse in the first few weeks of therapy, and should possibly consider waiting until dysfunction has stabilised prior to beginning

vestibular therapy. The clinician should also provide the patient with this information, and they should decide from a financial point of view when therapy should begin. Should the patient have limited funds, perhaps therapy should only begin once dysfunction has stabilised.

- Based on the significant associations found between balance confidence and perceived dizziness, it is strongly indicated that clinicians should measure and take into account the balance confidence score of the patient when planning therapy. Patients with low balance confidence do not necessarily do worse in therapy, however may not improve in the first few weeks. These patients may stagnate in therapy or default from therapy, should balance confidence not be addressed. The current study hypothesised that their low confidence may cause less carry-over into their home environment, therefore compensation takes longer. It may be necessary for participants who are identified as having low confidence to be brought in for more regular physiotherapy and less home program based therapy, to accommodate for this. The ABC was shown to be a useful tool in measuring balance confidence.
- Gender is another aspect which clinicians should take into account when planning therapy. The current study showed that male patients are more likely to improve than their female counterparts. Previously conducted research has shown that well informed patients demonstrated more success in therapy (Shepard & Telian, 1995). Thus female patients should be informed and counselled regarding the possible longer period they would need in vestibular therapy.
- Under certain criteria, the presence of anxiety was shown to influence therapy positively. The current study hypothesised that based on research by Mendel et al. (1999), psychological support is essential for success in vestibular therapy; and should be considered by clinicians for all patients, not only those with anxiety.

- The result that the presence of central signs and anxiety together, even when the patient has good balance confidence, causes the patient to not improve; highlights the need for the clinician to take central signs and anxiety seriously, and to provide for possible longer times in therapy. They should also inform their patients of the potential increased time periods and financial burden.
- Clinician should take into account that patients who are older than 50 years of age may have a more positive outcome in vestibular therapy. As mentioned earlier it is hypothesised that these patients, between the ages of 50 and 65 years, are often in positions of higher responsibility and provision than their counterparts. It is hypothesised that these patients may be more motivated to return to these roles in their work and homes, and the therapist should use this motivation in their therapy.

5.3.2: Implications for future research

- The current study has provided information on the South African population in vestibular therapy. As mentioned earlier, there is very little information on the South African population with vestibular disorders and in vestibular therapy. Although the current study provides some insights, there is still much that needs to be learnt. The current study provided us with tools for the South African population in a private practice context; more information is however needed within the public healthcare sector. Much of the information is likely to be transferable. However there are other characteristics which may come into play when looking into the public sector such as more limited finances and resources, other comorbid pathologies such as TB and/or HIV/AIDS, and longer time periods between therapy sessions. Although very little research has been conducted into vestibular therapy in the South African context, some research into vestibular function and HIV/AIDS has been conducted. South

Africa has the highest prevalence of HIV/AIDS in the world and research by Heinze et al. (1984) has shown that immunodeficiency is known to influence vestibular function, therefore there is the need to explore this facet of vestibular work especially in South Africa..

- Although not explicitly researched in this study, it was noted that in this clinic there was a significantly prolonged time period with symptoms before patients sought help. The majority of patients took an estimated two years before they began vestibular therapy, from the onset of their symptoms. Further research is needed in the reasons as to why there is this delay in patients seeking help or delay in referral to the correct treatments.
- Fluctuating dysfunction is an area which has consistently shown a negative effect on vestibular therapy outcomes, when compared to patients who do not have fluctuating dysfunction. More research is needed where patients with fluctuating dysfunction are compared to each other, specifically looking into whether they would improve with vestibular therapy while still experiencing dysfunction or whether they should wait until dysfunction has stabilised.
- When looking into the area of balance confidence, the current study showed that and ABC score of less than 43.75% was considered a negative influence on vestibular therapy outcomes. Previous research conducted by Powell and Myers (1995), suggested that less than 50% was considered a low level of balance confidence and thus though that therapy would be negatively affected. The percentage cut-off of what is considered a low level of balance confidence should be researched further.
- The relationship that was found between the presence of fluctuating dysfunction and the lateralisation of the pathology to the right ear should be investigated further.

- The influence of a patient being 50 years or older as a positive for vestibular therapy outcomes, suggested that there may be an age range when slightly increased age is a positive aspect. However, as per previous research, increased age is often associated with decreased success in vestibular therapy. Research is needed into, at what point increased age becomes a positive influence, and at what point increased age becomes a hindrance to therapy outcomes.
- Further research is needed into the area of multiple diagnoses for dizziness, specifically how multiple diagnoses may influence vestibular therapy outcomes, as well as the effectiveness of current protocols of assessments to find the correct diagnosis or diagnoses.
- The presence of epilepsy and its effect on therapy outcomes was not successfully addressed in the current study, due to the small number of participants who presented with it. Epilepsy is a condition where dizziness is expected, however the effect on VRT is inconclusive.
- A circulatory or vascular disorder, and thyroid problems that are well managed, may not present with dizziness; therefore these comorbid pathologies would not influence therapy outcomes. Further research should therefore be conducted into unmanaged circulatory or vascular disorders, and thyroid problems; and their influence on vestibular therapy outcomes.
- Other characteristics that should be investigated, when looking into characteristics that may influence therapy outcomes, were the frequency that the participant attended rehabilitation, the approach to vestibular rehabilitation that was used and the duration of therapy.
- The profiles that were obtained in this study are unique in many aspects and more research into these profiles should be conducted. Larger sample sizes as well as

differing contexts, such as public and private facilities, should be included. A longer time period between measurements should also be considered to allow for the participants to undergo more therapy before the outcome is measured.

- The outcome measure for progress in therapy for the current study was a subjective measure of patient perception. It would be beneficial to allow for an objective outcome measure to be included as well, perhaps the length of time patients undergo vestibular therapy.

5.3.3: Implications for policy

- More information on characteristics that may prolong the patient's time in therapy may allow for public and private medical systems to provide sufficient funds and realistic time provisions for therapy cover.
- With more information as to which patients may require therapy for longer periods of time, clinics will be able to make the necessary arrangements for time frames and finances to be incurred.

5.4: Final thought

In closing, through this study's demonstration that therapy is influenced by more than single patient characteristics, it has stressed the need for patients to be treated holistically. To this end, the importance of a multidisciplinary team approach was also highlighted. Multidisciplinary teams should include doctors of varying disciplines, depending on the comorbid pathologies, audiologists, physiotherapists, occupational therapists, psychologists and the patient. It is the hope of this study, that with the information and trends identified, optimal patient care and patient satisfaction in the area of dizziness can be achieved.

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Appendix A: Letter of informed consent

Appendix A

Information sheet:

Good day

My name is Margot Hamman and I work at Sandton Hearing & Balance which you visited for some dizziness difficulties. I am currently completing my Masters in Audiology at the University of the Witwatersrand, Johannesburg.

I am conducting a research study on dizziness. I am looking into what characteristics may influence success in therapy for dizziness. I am hoping to include all the people who attended the clinic in the last four years. I am asking for permission to look at your file from when you attended the clinic. No personal information will be shared and you are not required to participate in any other way. The characteristics I will be looking at are the diagnosis, the degree of the damage to the ear causing the dizziness, which ear was involved, the time lapse from onset of symptoms to the start of therapy, if any co-occurring aliments are present and how many, age, gender, and lastly the diagnosis or diagnoses for the dizziness. This research study will be supervised by Mr. Victor de Andrade and Mrs. Luisa Petrocchi-Bartal, lecturers and audiologists at the Department of Speech Pathology and Audiology at the University of the Witwatersrand.

The results of this research study may help us bring awareness for change in the management of dizzy people, provide the correct support services for those in need, and provide information needed for appropriate management in the area of dizziness for the patient and the therapist.

Should you choose to allow us to use your information; you also have the right to withdraw the use of your information from the research study at any time, without consequences.

If you have any further concerns or questions please do not hesitate to contact me at:

Cell phone: 082 905 0075

E-mail: margot_hamman@yahoo.co.uk

If you are willing to allow us to use your information please complete the following form and either fax/e-mail/hand deliver them to me at:

Fax: 086 716 0082

E-mail: margot_hamman@yahoo.co.uk

Physical Address: Balance and Dizzy Matters

Rehab Matters

1 De La Rey Road

Rivonia

I am also willing to collect them from you.

Kind regards,

Margot Hamman

MA Student

Victor de Andrade and Luisa Petrocchi-Bartal

Supervisors

Appendix A

CONSENT FORM

I, _____ (name of participant) hereby agree to allow the data in my records to be used as part of the record review, as presented in the information sheet.

I understand the above described process involved in the research and hereby give consent for the researcher access and analyse the data in my records.

I understand that I will allow my records to be used anonymously for analysis and interpretation

I understand that participation is voluntary and I can choose withdraw from the research study at any time, with no negative consequences.

I understand that all information will be kept private. All information pertaining to me will only be seen by the researcher involved.

I understand that the results found will be written in a research report. I can have the results of this research study if I want them.

I understand that the raw data will be kept for 2 years following any publication or for 6 years if no publications emerge from the research.

Appendix A

Participant Name	Participant Signature
Date and Place	
Margot Hamman	
Researcher Name	Researcher Signature
Date and Place	
Witness Name	Witness Signature
Date and Place	

Appendix B: Human Research Ethics Committee (Medical) clearance certificate

R14/49 Ms Margot Hamman

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M131111

NAME: (Principal Investigator)	Ms Margot Hamman
DEPARTMENT:	Speech Pathology and Audiology The Balance and Dizzy Matters Clinic, Johanneburg
PROJECT TITLE:	The Patient Characteristics that may Influence Vestibular Therapy Outcomes and How Vestibular Therapy is affected; in a Private Practice Setting in Johanneburg, South Africa: A Retrospective Record Review
DATE CONSIDERED:	29/11/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Mr Victor De Andrade and Mrs Luisa Petrocchi-Bartal
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	17/01/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix C: Faculty of Humanities proposal outcome

University of the Witwatersrand, Johannesburg

Faculty of Humanities – Postgraduate Office

Private Bag 3, Wits 2050, South Africa • **Tel:** +27 11 717 4002• **Fax:** +27 11 717 4037• **Email:** Sarah.Mfupa@wits.ac.za

Student Number: 0701992G

Miss Margot Hamman
Sandton Mediclinic
North Block
Ground Floor
Room G06
Johannesburg 2021
Gauteng South Africa

17 February 2014

Dear Ms Hamman

APPROVAL OF PROPOSAL FOR THE DEGREE OF MASTER OF ARTS IN AUDIOLOGY BY RESEARCH

I am pleased to be able to advise you that the readers of the Graduate Studies Committee have approved your proposal entitled "*The patient characteristics that may influence vestibular therapy outcomes and how vestibular therapy is affected: in a private practice setting in Johannesburg, South Africa: A retrospective record review*". I confirm that Mrs Luisa Petrocchi-Bartal and Mr Victor de Andrade been appointed as your supervisors in the School of Human and Community Development.

The research report is normally submitted to the Faculty Office by 15 February, if you have started the beginning of the year, and for mid-year the deadline is 31 July. All students are required to RE-REGISTER at the beginning of each year.

You are required to submit 2 bound copies and one unbound copy plus 1 CD in pdf (Adobe) format of your research report to the Faculty Office. The 2 bound copies go to the examiners and are retained by them and the unbound copy is retained by the Faculty Office as back up.

Please note that should you miss the deadline of 15 February or 31 July you will be required to submit an application for extension of time and register for the research report extension. Any candidate who misses the deadline of 15 February will be charged fees for the research report extension.

Kindly keep us informed of any changes of address during the year.

Note: All MA and PhD candidates who intend graduating shortly must meet your ETD requirements at least 6 weeks after your supervisor has received the examiners reports. **A student must remain registered at the Faculty Office until graduation.**

Yours sincerely

Miss Sarah Mfupa
Faculty Officer
Postgraduate Division
Faculty of Humanities

UNIVERSITY OF THE WITWATERSRAND
FACULTY OF HUMANITIES
2014 -02- 17
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JOHANNESBURG