THE DEVELOPMENT AND VALIDATION OF THE VESTIBULAR ACTIVITIES AVOIDANCE INSTRUMENT FOR PEOPLE WITH VESTIBULAR AND BALANCE DISORDERS

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Background: Vestibular disorders result in physical and psychological consequences that have significant impact on individuals' activities of daily living (ADL) and their overall quality of life (QOL). As a result of these negative consequences, many people with vestibular disorders tend to avoid activities, limit their movement and avoid specific circumstances because of their fear of provoking symptoms and unanticipated dizziness or unsteadiness attacks. These activities are very important in facilitating compensation, and avoiding them contributes to disability. However, specialized outcome measures that identify those people who may avoid activities do not exist.

Purpose: To develop and validate a new self-report measure that identifies those with vestibular and balance disorders who may avoid activities.

Methods: A list of 111 candidate items were generated and included in a survey. The survey was then sent to a panel of clinicians and researchers specializing in vestibular disorders and agreement was obtained on the items to include in the Vestibular Activities Avoidance

Instrument using the Delphi technique. The psychometric properties of the new outcome self-report measure were established including test-retest reliability; minimum detectable change at 95% confidence level (MDC95), and internal and external validity. The test-retest reliability ofthe Activities Avoidance total score was estimated using the Intra Class Correlation Coefficient (ICC). Validity was examined using the SF-12, and 2-question disability questionnaire.

Results: Of the 111 vestibular activities avoidance items, 34 of them had 70% or greater agreement for inclusion in the Vestibular Activities Avoidance Instrument. The test-retest reliability of the Vestibular Activities Avoidance Instrument total score was excellent (ICC=.97; confidence interval, 0.95-0.98). Weighted kappa for the VAAI agreement per-item was poor to excellent (0.1-0.8). The SEM of the VAAI was 13.2 and the minimum detectable change (MDC) for the VAAI total score was 36.5. The Vestibular Activities Avoidance Instrument had strong correlation with both mental and physical composite scores of the SF-12.

Conclusion: The Vestibular Activities Avoidance Instrument was developed to determine which factors predict avoidance of activities and thus may negatively influence outcomes. The Activities Avoidance demonstrated excellent reliability and was validated with the SF-12, disability questionnaire.

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PREFACE

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1.0 INTRODUCTION

Dizziness, vertigo, and imbalance are considered to be among the most frequent complaints in medical practice globally and in the United States (Agrawal, Carey, Della Santina, Schubert, & Minor, 2009; Jonsson, Sixt, Landahl, & Rosenhall, 2004; Kerber, Brown, Lisabeth, Smith, & Morgenstern, 2006). Dizziness may impact approximately one quarter of the population (Agrawal et al., 2009), e.g. more than 69 million Americans in the United States 40 years of age or greater may have vestibular dysfunction (Agrawal et al., 2009). Moreover, dizziness and vertigo are also common complaints in emergency setting in Europe (Karatas, 2008) .

Vestibular disorders result in devastating physical and psychological consequences that have significant impact on individuals' activities of daily living (ADL) and their overall quality of life (QOL) (H. S. Cohen & Kimball, 2000; Mira, 2008; White, Savvides, Cherian, & Oas, 2005). Hence, vestibular disorders contribute to placing burden on individuals, the economy, health care and an individuals' disability (Gamiz & Lopez-Escamez, 2004; Mira, 2008). The physical consequences of vestibular disorders, which lead to individual disability include unsteadiness, imbalance, and falls (Agrawal et al., 2009). Agoraphobia, panic disorders, anxiety, and depression are all psychological sequelae that are reported by up to 50% of people with vestibular disorders (Yardley, Owen, Nazareth, & Luxon, 2001).

As a result of these negative consequences, many people with vestibular disorders tend to avoid activities, limit their movement and avoid specific circumstances (visually busy environments) because of their fear of provoking symptoms and unanticipated dizziness or unsteadiness attacks (Mira, 2008; S. L. Whitney et al., 2016; S. L. Whitney, Alghadir, A., Alghwiri, A., Alshebber, K. M., Alshehri, M., Furman, J. M., Muller, M., Grill, E., In press; Yardley & Redfern, 2001); (Honaker, Gilbert, Shepard, Blum, & Staab, 2013). These environments are very important in facilitating compensation, and avoiding them contributes to greater disability (Yardley & Redfern, 2001). Consequently, fear of unpleasant provoking symptoms impact affected individuals with vestibular disorders function and productive work life (White et al., 2005).

Psychological distress (anxiety and depression) is greater in patients with vestibular disorders than in the general population (Yardley, Masson, Verschuur, Haacke, & Luxon, 1992). Vertigo and anxiety are often related (Balaban & Jacob, 2001; (Furman & Jacob, 2001; Staab, 2006; Staab & Ruckenstein, 2005). Approximately 50% of people with dizziness have psychological problems and more than 25% show panic symptoms, agoraphobia, and 11% comorbid incidence of dizziness and anxiety (Eckhardt-Henn, Breuer, Thomalske, Hoffmann, & Hopf, 2003; Yardley, Beech, Zander, Evans, & Weinman, 1998; Yardley, Owen, Nazareth, & Luxon, 2001). Hence, there is a need to take emotional and behavioral aspects into consideration in the diagnosis and treatment of patients reporting dizziness since these co-morbidities can delay recovery if not addressed during rehabilitation.

There are several self-reports instruments in the literature that quantify the impact of dizziness on daily life, the disabling consequences of vertigo on activities of daily living (ADL), social life, and leisure (Alghwiri et al., 2012; H. S. Cohen & Kimball, 2000; Jacobson & Newman, 1990; Yardley & Putman, 1992). However, none of these instruments were designed to identify those persons who avoid activities as a result of their fear of a new dizziness episode. Therefore, a specialized instrument is needed to help clinicians and researchers to identify individuals with vestibular and balance disorders who may avoid activities in order to prescribe an appropriate intervention. Early identification of avoidance behaviors may help clinicians quickly identify that the person may need specialized care.

1.1 STATEMENT OF PROBLEM

There is clear evidence of the debilitating effects of vestibular and balance disorders on patients' activities and quality of life; however, a specialized outcome measure that identifies those people who may avoid activities does not exist.

1.2 THE PURPOSE

The purpose of this study was to develop and validate a new outcome self-report measure that identifies individuals with vestibular and balance disorders who may avoid activities and may even develop a fear of exercise.

1.2.1 Specific aims

1) To identify and select key activity avoidance items from eight self-report instruments that relate to perceived handicap, self-perceived support, somatization, fear avoidance, fear of movement, and anxiety and/or depression. The identified instruments include: 1) The Dizziness Handicap Inventory (DHI); 2) The Patients Health Questionnaire (PHQ-9); 3) The Patients Health Questionnaire (PHQ-15); 4) The Generalized Anxiety Disorder Assessment (GAD-7); 5) The Tampa Scale of Kinesiophobia; 6) The Fear Avoidance Beliefs Questionnaire (FABQ); 7) The Short Health Anxiety Inventory (SHAI); and 8) The Multidimensional Scale of Perceived Social Support (MSPSS). The development of the new outcome measure, named the Vestibular Activities Avoidance Instrument (VAAI) will be achieved using the Delphi technique. The goal of the VAAI is to assess avoidance of activities that may negatively affect treatment outcomes

2) To examine the reliability (test-retest) and validity of the VAAI in people with vestibular disorders.

2.0 BACKGROUND AND SIGNIFICANCE

2.1 PREVALENCE OF VESTIBULAR DISORDERS

Dysfunction of the vestibular system is manifested by a wide range of symptoms including basic perceptual symptoms like unsteadiness, dizziness, vertigo, and emotional problems (Borel, Lopez, Peruch, & Lacour, 2008). Vertigo, dizziness, and unsteadiness that result from vestibular and non-vestibular disorders are considered to be among the most frequent reasons for seeking consultation in medical practice (Agrawal et al., 2009; Jonsson et al., 2004; Kerber et al., 2006). Epidemiology studies in vestibular disorders provide us with a greater understanding of the burden of vestibular disorders, their consequences, frequency and distribution in the general population and thus improve our knowledge about the primary causes of the disease and assists in improving patient care (Neuhauser, 2007).

According to existing data, approximately 20% to 35% of people in the general population complain of dizziness and vertigo (Burt & Schappert, 2004; Karatas, 2008). It was estimated that there were about 7.5 million patients complaining of dizziness examined annually in the United States ambulatory care settings (Burt & Schappert, 2004; Karatas, 2008). Moreover, more than 69 million Americans in the United States over 40 years of age may have vestibular dysfunction, which described as vertigo and unsteadiness due to disturbances in gaze and postural stability (Agrawal et al., 2009; Tian JR, 2001). According to a study conducted by

Yardley et al. 1 in 10 adults experience handicapping dizziness, and approximately 33% of those with handicapping dizziness report symptoms of vertigo (Yardley, Owen, Nazareth, & Luxon, 1998). Anderson et al. claim that 15% of physiological vertigo is caused by central processing disorders including disorders of the cerebellum, brainstem or projections to the cerebral cortex while 85% is caused by deficits of the peripheral system including the vestibular organs and nerve (Anderson, Yolton, Reinke, Kohl, & Lundy-Ekman, 1995). The German National Health Interview Survey investigated the epidemiology of vestibular vertigo in a representative sample from the general population and showed that that the life-time prevalence of vestibular vertigo in adults aged 18-79 years was 7.8%, the one year incidence was 1.5%, the one year prevalence was 5.2% with greater complaints of dizziness in women and an 88% vertigo recurrence (Neuhauser et al., 2008). Moreover, vertigo impacts daily activities in 40% of affected patients, 41% of sick leaves, and 19% of people avoid leaving their home (Neuhauser et al., 2008).

2.2 CONSEQUENCES OF VESTIBULAR DYSFUNCTION

Vestibular disorders can lead to physical and psychological consequences that have significant impact on individuals' activities of daily living (ADL) and their overall quality of life (QOL) (Mira, 2008; White et al., 2005). These consequences can lead to an individuals' disability by limiting their activities and restricting their participation within the community in order to avoid provoking symptoms of unexpected episodes of dizziness or disequilibrium (Mira, 2008; Yardley & Redfern, 2001). Physical consequences include unsteadiness, imbalance, and falls (Agrawal et al., 2009). Agoraphobia, panic disorders, anxiety, and depression are all psychological disturbances that were reported by 50% of people with vestibular disorders (Yardley, Owen, Nazareth, & Luxon, 2001).

As a result of the negative consequences, people with vestibular disorders may avoid activities, limit their movement and avoid specific circumstances and environments because of their fear of provoking symptoms and unanticipated dizziness or unsteadiness attacks (Mira, 2008; Yardley & Redfern, 2001). Those activities and environments are very important in facilitating compensation and avoiding them contributes to greater disability (Yardley & Redfern, 2001). Consequently, fear of unpleasant provoking symptoms impact affected individuals' function and productive work life (White et al., 2005). In a multi-cultural cross sectional study that was done in persons with vestibular disorders, visually complex or movement in the environment appeared to increase their dizziness/balance problem. The most frequent environments were: quick movements, crowds, design of buildings e.g. narrow hallways, stairs, and elevators (S. L. Whitney et al., 2016).

2.2.1 Physical consequences

Vestibular disorders may impact postural control and result in instability in stance, during ambulation, as well as during transitional activities. It is well documented that symptoms of vestibular disorders including dizziness, unsteadiness and imbalance are highly correlated with an increased incidence of falls particularly amongst the elderly (Pothula, Chew, Lesser, & Sharma, 2004) (Herdman, Blatt, Schubert, & Tusa, 2000) (S. L. Whitney, Hudak, & Marchetti, 2000). Impairments of the vestibular system manifested by unsteadiness and imbalance increase with age (Pothula et al., 2004). Thus, vestibular disorders have been increasingly associated with falls (Pothula et al., 2004) (Kristinsdottir, Jarnlo, & Magnusson, 2000). A cross sectional study reported that unrecognized benign paroxysmal positional vertigo (BPPV) has an incidence rate of 9% amongst the elderly, and those with unrecognized vertigo are more likely to have experienced falls during the last 3 months (Oghalai, Manolidis, Barth, Stewart, & Jenkins, 2000). Data from another study showed that 80% of patients who visited an Accident and Emergency Department with no known cause of a fall had symptoms of vestibular deficits, and 40% of those complained of vertigo (Pothula et al., 2004). Therefore, identifying and treating those with vestibular impairment is very important in order to reduce their symptoms and possibly reduce their risk of falls.

2.2.2 Psychological consequences

Some individuals with balance dysfunction experience psychological distress after a vestibular disorder. Moreover, there is well-established evidence in the medical literature that psychologic distress is higher among those people who experience vertigo and anxiety (Balaban & Jacob, 2001). Data from studies reported that approximately 50% of individuals with dizziness reported some psychological problems (Yardley et al., 2001) (Eagger, Luxon, Davies, Coelho, & Ron, 1992). Moreover, more than 25% of those complaining of dizziness present with psychological symptoms including panic disorders and agoraphobia, with 11% comorbid incidence of anxiety and dizziness (Yardley et al., 2001). A retrospective review of individuals treated for psychogenic dizziness with or without physical neuro-otologic abnormalities found that the cause was an anxiety disorder in 33% of people complaining of dizziness (Staab & Ruckenstein, 2003). Moreover, neuro-otologic disorders exacerbated preexisting psychiatric conditions in 34% of subjects, and vestibular dysfunction or depressive disorders in 33% of subjects (Staab &

Ruckenstein, 2003). Thus, primary anxiety disorders could cause dizziness as well as physical neuro-otologic disorders may trigger psychopathology (Staab & Ruckenstein, 2003).

Chronic vertigo is considered to be a psychologically disabling symptom. Patients with chronic vertigo have the potential to develop somatization because of difficulty in identifying the origin of the dizziness and the fear of unanticipated vertigo attacks (Monzani, Casolari, Guidetti, & Rigatelli, 2001). Somatization is defined as “the physical expression of psychological or social distress suggestive of underlying psychiatric morbidity” (Monzani et al., 2001). Data from a study of individuals diagnosed with peripheral vestibular disorders showed that there is a relationship between vestibular symptoms and psychiatric morbidity, which is correlated with measures of anxiety, perceived stress and previous psychiatric illness (Eagger et al., 1992). Fifty percent of patients with peripheral vestibular disorders have psychological symptoms, depression, and panic disorder with or without agoraphobia (Eagger et al., 1992). Moreover, those with acute vertigo may experience severe anxiety attacks, with psychological ramifications causing disproportionate disability (Pollak, Klein, Rafael, Vera, & Rabey, 2003). Consequently, psychological factors may aggravate vertigo and delay recovery (Yardley & Redfern, 2001). Data from a controlled study of people with vertigo showed that their fear of becoming dizzy was highly correlated with their perception of disability (Monzani et al., 2001). The authors emphasized the necessity of a psycho-education program in order to raise awareness of factors that affect the patients’ QOL negatively with the collaboration of the otologist/neuro-otologist (Monzani et al., 2001).

There is clear evidence that vestibular and balance disturbances have a dramatic impact on patients’ QOL and contribute to disability. Psychological deficits can affect recovery from vestibular disorders if not addressed during rehabilitation (Mira, 2008; Soderman, Bagger-Sjoback, Bergenius, & Langius, 2002).

2.3 PHYSIOLOGICAL LINK BETWEEN ANXIETY AND VESTIBULAR DISORDERS

Balaban and Thayer (Balaban & Thayer, 2001) provided physiological evidence of the links between the vestibular system and anxiety. They stated that the comorbidity of anxiety and balance disorders is most likely due to the shared neural circuit pathways for control of vestibular processing, emotional response, autonomic function, and anxiety (Balaban & Porter, 1998; Damasio, 1998; Goddard & Charney, 1997). The center of this circuitry is the parabrachial nucleus network, which is a site of convergence of vestibular and visceral information processing in pathways that appear to be involved in avoidance condition, emotional and autonomic responses, anxiety, and conditioned fear. The shared central neural circuits are linked with systems of balance perception and postural control (Balaban & Thayer, 2001).

In the brainstem, the connections between the vestibular nuclei and the parabrachial nucleus are the link between the vestibular system and the neural networks involved in anxiety and emotions (Charney & Deutch, 1996). The parabrachial nucleus is a center for regulation of physiologic manifestations of fear avoidance and anxiety (Goddard & Charney, 1997). These connections develop information about whole body rotation and position with respect to gravity. Visual and somatosensory inputs travel from the amygdala via connections from the superior colliculi and thalamus. The information in the threat assessment pathway then travels rostrally to the limbic and vestibular cortices (hippocampus, dorsolateral prefrontal cortex, insula, and anterior cingulate), where the information is processed and the threat is assessed (Dieterich & Brandt, 2008). The vestibuloparabrachial network and the amygdala-locus coeruleus outputs converge on brainstem autonomic centers (Balaban, 2004). Serotonergic and nonserotonergic projections from the raphe nucleus to the vestibuloparabrachial network facilitate a tradeoff between instinctive motor activation and responsiveness to sensory inputs (Halberstadt & Balaban, 2006). Similarly, the same projections to the amygdala and red nucleus modulate threat reactions and conditioned fear and anxiety responses (Halberstadt & Balaban, 2006). Monoaminergic projections from the raphe nucleus drive levels of alertness and arousal (Etkin, 2010). Also, these projections adjust the sensitivity of sensory nuclei and cognitive pathways that influence processing of vestibular, visual, and somatosensory inputs as well as conscious attention to objects in the environment, postural control, and locomotor tasks (Etkin, 2010).

After a vestibular disturbance, people experience symptoms such as nausea and sweating because of the neurological links between the autonomic nervous system and the vestibular system (Brandt, 2000; Yardley & Redfern, 2001). Autonomic symptoms can also be induced by anxiety arousal (Balaban & Thayer, 2001). Those provoked symptoms create a vicious cycle of prolonged symptomatology and distress, as symptoms can be augmented by anxiety and, in turn, fuel further anxiety (Furman & Jacob, 2001). People with vestibular disorders reported elevated levels of anxiety (Soderman et al., 2002).

It has been suggested by cognitive behavioral approaches that cognitions about illness and its consequences are related to how people respond emotionally to their illness (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995). Anxiety in people with chronic illness is likely to be related to excessive catastrophic concerns (Weinman J., 1996). When people with vestibular disorders experience dizziness, they may interpret this catastrophically and this leads to fear development (Yardley, 1994). Waddell et al, when studying back pain, has reported that some patients feel that movement is harmful for them and should be avoided (Waddell, Newton, Henderson, Somerville, & Main, 1993).

Part of this study will attempt to determine if the perception that movement is harmful and should be avoided affects patient outcomes in persons living with balance and vestibular disorders.

2.4 FEAR AVOIDANCE

Vlaeyen et al. defined fear of movement as “a specific fear of movement and physical activity that is (wrongfully) assumed to cause reinjury” (Vlaeyen, Kole-Snijders, Rotteveel, Ruesink, & Heuts, 1995). Kori et al. defined kinesiophobia as “an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury” (Kori SH, 1990). Fear of injury was more disabling than the injury itself (Crombez, Vlaeyen, Heuts, & Lysens, 1999). There are several models that describe the impact of non-physical factors on the development of chronicity and treatment resistance. Amongst the more widely investigated is the fear-avoidance beliefs model introduced by Lethem et al (Lethem, Slade, Troup, & Bentley, 1983; Slade, Troup, Lethem, & Bentley, 1983) that has been further refined by Vlaeyen et al. (Vlaeyen, Kole-Snijders, Boeren, et al., 1995).

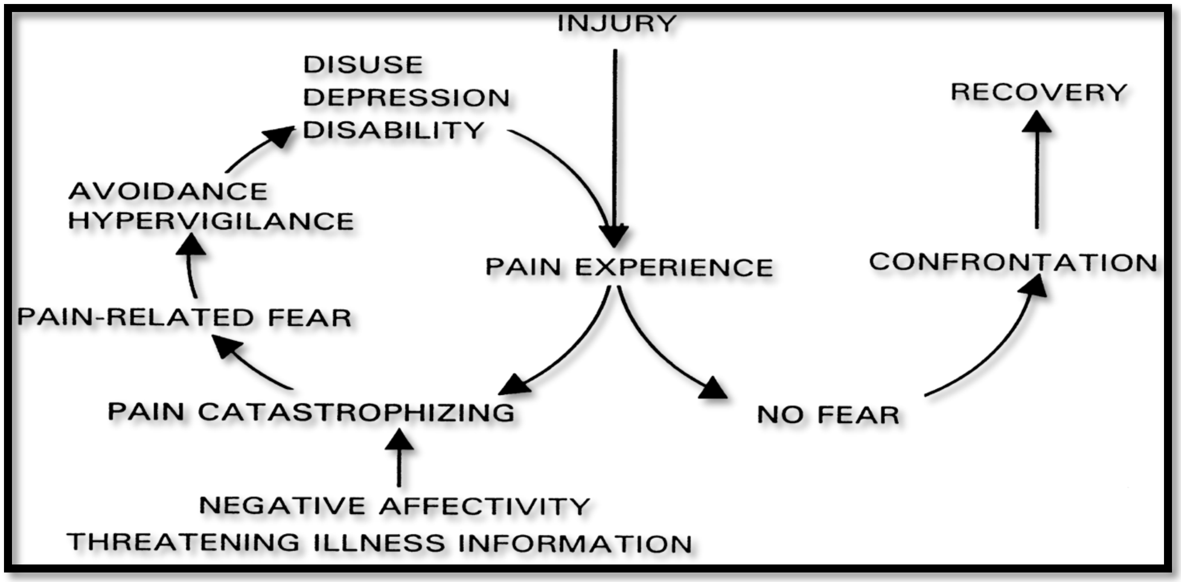

Figure 1. A cognitive behavioral model of fear avoidance (based on Vlaeyen et al., 1995)

Vlaeyen et al presented their fear avoidance model in 1995, which aids in tying several findings from the current literature together concerning the role of fear-avoidance in disability and delays in recovery (Figure. 1). The model suggests two opposing behavioral responses: confrontation and avoidance, and it presents potential pathways that injured patients might take and result in recovery or avoidance, disability and depression. Avoiders tend to restrict their activities, which is claimed to predispose them toward reducing fitness (disuse), depression, persistent pain and increasing disability. The fear avoidance model as it relates to low back pain (LBP) is made up of a number of components including: catastrophizing, fear avoidance beliefs and self-efficacy. A modified version of the classic fear avoidance model is included in Figure 2. In the model, fear of pain is replaced with fear of becoming dizzy. Dizziness and pain have similar characteristics in that they can both have rather sudden onset and may or may not always be predictable.

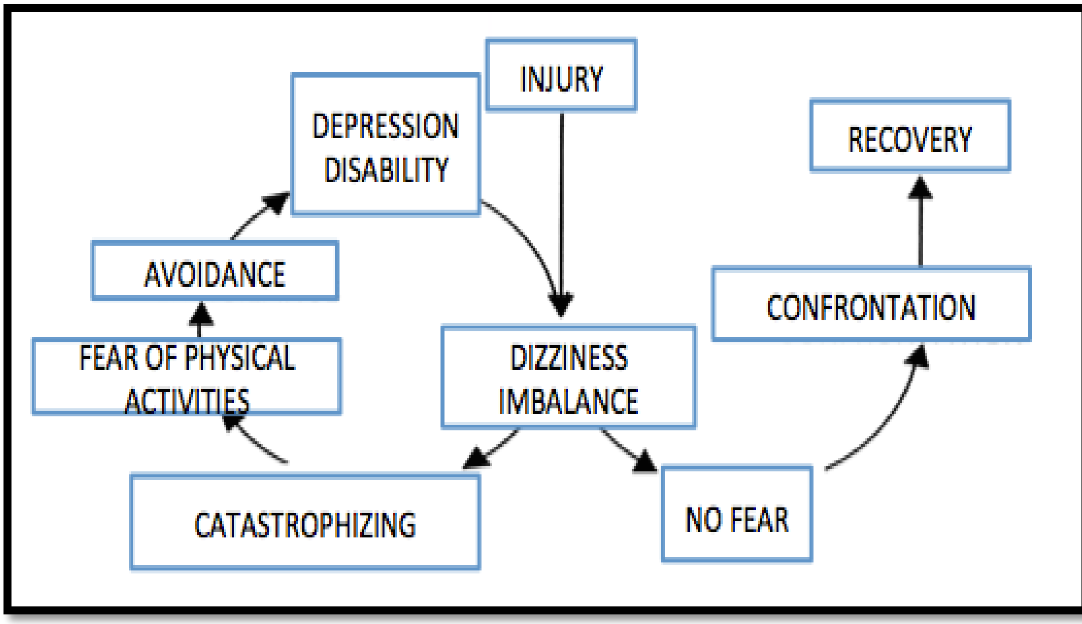

Figure 2. A modified version of the classic fear avoidance model

Catastrophizing is "an exaggerated and negative orientation toward pain stimuli and pain experience" and individuals who catastrophize expect that they will begin a new episode of pain or injury which then stimulates fear of motion (Buer & Linton, 2002). Catastrophization has been shown to be a significant and independent predictor of response to treatment and development of chronicity in persons with back pain (Buer & Linton, 2002) (Gauthier, Sullivan, Adams, Stanish, & Thibault, 2006). In the fear-avoidance model, catastrophization is proposed to affect an individual by increasing fear of activity and eventually increasing the risk of subsequent psychological distress and depression (Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995).

The term fear-avoidance belief (FAB) refers to "aberrant or excessive concerns individuals may hold regarding the likelihood of their causing re-injury by performing activities". These beliefs are considered to be significant if they cause people to change their activities (fear-avoidance behavior). Fear-avoidance beliefs are perceived to be predictive of outcomes of care and future disability (Butterfield, Spencer, Redmond, Feldstein, & Perrin, 1998; George, Fritz, & Childs, 2008). Persons with low back pain with high FAB's have a poorer response to physical treatments compared to those with lower scores on the FAB (lower scores indicate less fear avoidance) (Mannion et al., 2001); (Cai, Pua, & Lim, 2007). Hence, fear of movement may encourage those with LBP to avoid activity and consequently enter the cycle proposed in the fear-avoidance model.

Self-efficacy is defined as “the belief in one's capabilities to organize and execute the actions required to manage prospective situations”(A, 1986). Individuals who feel that they can accomplish tasks, where their self-efficacy belief is stronger than any FAB they hold, will confront their pain and remain active. This could make them less likely to become locked into the cycle of fear, avoidance, disuse and pain (Denison, Asenlof, & Lindberg, 2004; Woby, Watson, Roach, & Urmston, 2004).

The fear avoidance model predicts possible ways that fear of movement can lead to disability. Irrational and negative ruminating about injury and its consequences, which is known as “catastrophic thinking”, is considered to be the origin of fear avoidance (McCracken & Gross, 1993). Fear of physical activity is associated with an increase in psychophysiological reactivity, when an individual is facing a situation that is appraised as “dangerous”, which in turn makes physical activity more difficult for the person (Vlaeyen et al., 1999). Fear of physical activity is just like any other form of fear or anxiety as it interferes with cognitive functioning. Fearful individuals focus more on the possible threat signal (hypervigilance) and tend to have difficulty shifting their attention away from threats. This will eventually affect other essential tasks such as active coping with daily life problems (Madelon L Petersa, 2000). Fear also leads to escape and avoidance behaviors, which results in not performing daily activities (especially those expected to cause injury). Consequently, avoidance of daily activities results in functional disability (Asmundson, Norton, & Allerdings, 1997).

Avoidance behaviors occur in anticipation of injury rather than as a response to injury. Wrongful expectations and beliefs about pain as a signal of physical harm may cause these behaviors to persist. Fearful beliefs may thus become dissociated from actual pain experiences. Longstanding avoidance and physical inactivity has a detrimental impact on the musculoskeletal and cardiovascular systems, leading to the so-called "disuse syndrome' (Bortz, 1984) both in terms of deconditioning (Wagenmakers, Coakley, & Edwards, 1988) and in guarded movements (Watson, Booker, Main, & Chen, 1997). Avoidance can lead to withdrawal from essential reinforcers leading to mood disturbances such as irritability, frustration and depression (McQuade, Turner, & Buchner, 1988).

Studies performed on individuals with back pain have identified physical factors that explain why some individual’s pain decreases quickly while others develop chronic conditions, despite treatment. However, psychological and social influences have a significant affect on response to treatment and the development of chronicity. Several cognitive and emotional domains have been found to be associated with persistent back pain including anxiety, depression, catastrohpization and fear-avoidance beliefs (Main & Waddell, 1991; Sullivan et al., 2001). Hence, these factors need to be taken into considerations alongside examination findings when deciding a management plan for persons with low back pain (LBP) (Sullivan & Stanish, 2003; Waddell, 1987). Previous studies have demonstrated that people with LBP who have high psychological factors are more likely to fail with physical treatment intervention. By identifying such subgroups that are unlikely to respond to physical therapy, treatment can be directed to pschologically-based alternatives with good success (Hill et al., 2008).

The role of fear avoidance beliefs and catastrophizing in the development of chronic pain and disability is well investigated in individuals with LBP. It also has been investigated in musculoskeletal disorders other than LBP. Hart et al investigated fear-avoidance beliefs in acute stages of upper and lower extremity disorders, neck pain and LBP, which indicate that fear avoidance beliefs are not specific to LBP and that it is present in other patients (Hart et al., 2009). Moreover, fear of movement is present in sport injuries. Recovery after ankle syndesmosis injury was reported to be related to fear avoidance beliefs (Sman et al., 2014). Minor pain and limitations to activities of daily living after surgical repair of proximal hamstring avulsions and return to activity correlated to fear of re-injury and not trusting the operated leg completely during physical activity (Skaara, Moksnes, Frihagen, & Stuge, 2013). The occurrence of kinesiophobia was seen in 60% of patients with exercises induced musculoskeletal pain (chronic compartment syndrome, medial tibial syndrome, peroneal tunnel syndrome and chronic leg pain) who presented with kinesiophobia (Lundberg & Styf, 2009). The highest level of kinesiophobia was found among the non-exercisers (Lundberg & Styf, 2009). Other investigators have reported a relationship between fear avoidance beliefs and long-term work disability and also between catastrophizing and long-term pain intensity in individuals with acute LBP (Gheldof et al., 2010; Wideman & Sullivan, 2011). These findings are supported by results of other studies that suggest that fear avoidance beliefs have a negative influence on functioning and recovery times in people with neck pain (George, Fritz, & Erhard, 2001; Landers, Creger, Baker, & Stutelberg, 2008), after anterior cruciate ligament surgery (Ross, 2010), patellofemoral pain (Piva, Fitzgerald, Wisniewski, & Delitto, 2009), musculoskeletal pain (Westman, Boersma, Leppert, & Linton, 2011), knee osteoarthritis (Scopaz, Piva, Wisniewski, & Fitzgerald, 2009), and shoulder pain (George & Stryker, 2011; Kuijpers et al., 2006). Therefore, it's really important to identify people presenting for intervention with elevated levels of fear across a wide variety of impairments who are likely to fail to improve with the standard care.

If elevated levels of fear are detected, alternative management strategies should be used to reduce fear and improve outcomes e.g. cognitive-behavioral and physical therapy intervention for people with LBP (Linton, Boersma, Jansson, Svard, & Botvalde, 2005).

2.5 COGNITIVE BEHAVIORAL THERAPY

Vestibular rehabilitation (VR) is often considered to be the optimal treatment for those with vestibular disorders (Telian & Shepard, 1996). Due to the shared neural circuit between the vestibular system and emotional processing centers for anxiety, there is a need to consider psychological treatment in order to address emotional and behavioral aspects in treating patients with vestibular dysfunction (Balaban & Porter, 1998; Damasio, 1998; Goddard & Charney, 1997). Disregarding patients' underlying behavioral avoidance and anxiety may affect treatment negatively.

While vestibular rehabilitation can improve vestibular symptoms, psychological problems could persist after treatment (Kapfhammer et al., 1997). Hence, addressing the psychological aspect including anxiety, beliefs, and behavior is really important for better outcomes. Therefore, it has been suggested to implement cognitive behavioral therapy (CBT) as an adjunct to vestibular rehabilitation (Beidel & Horak, 2001) since it help patients to change the way they respond emotionally to their illness by teaching them to alter their behavior and confront their distorted thinking. Cognitive behavioral therapy has been shown to be very effective in symptoms reduction (Andersson, Asmundson, Denev, Nilsson, & Larsen, 2006; Holmberg, Karlberg, Harlacher, Rivano-Fischer, & Magnusson, 2006; Johansson, Akerlund, Larsen, & Andersson, 2001). Cognitive behavioral therapy has been also recommended in the treatment of anxiety disorders (Barlow, 2001). In a randomized controlled trial, a treatment program consisted of both CBT and VR was successful in treating dizziness in older adults (Johansson et al., 2001).

The benefit of adding CBT to VR is that CBT has been proven to address anxiety and avoidance of activities, especially those involving head movements, which limits positive outcomes of vestibular treatment (Andersson et al., 2006; Holmberg et al., 2006; Johansson et al., 2001).

2.6 MEASURES USED IN DEVELOPING THE VESTIBULAR ACTIVITIES AVOIDANCE INSTRUMENT

In order to construct one instrument that contains a comprehensive list of important domains (emotional, physical, behavioral, depression, anxiety, fear avoidance and work avoidance), eight valid and reliable instruments were used to establish the Vestibular Activities Avoidance Instrument including the Dizziness Handicap Inventory (DHI) (Jacobson & Newman, 1990), the Patient Health Questionnaire (PHQ-9) (Spitzer et al., 1999), the Patient Health Questionnaire (PHQ-15) (Kroenke, Spitzer, & Williams, 2002; Spitzer, Kroenke, & Williams, 1999), the

Generalized Anxiety Disorder Assessment (GAD-7) (Spitzer, Kroenke, Williams, & Lowe, 2006), the Tampa Scale of Kinesiophobia (Kori SH, 1990), the Fear Avoidance Beliefs Questionnaire (FABQ) (Waddell et al., 1993), the Short Health Anxiety Inventory (SHAI) (Salkovskis, Rimes, Warwick, & Clark, 2002), and the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet, Dahlem, Zimet, & Farley, 1988).

In order to be able to determine which factors of vestibular dysfunction and psychiatric variables can predict disability/functional impairment, we selected various measures and ended up with the most potent, simple, and short self reports.

2.6.1 The Dizziness Handicap Inventory (DHI)

The DHI is a 25-item self-report questionnaire developed to quantify the impact of dizziness on daily life by measuring self-perceived handicap (Jacobson & Newman, 1990). It consists of three domains: 9 functional questions that are worth thirty-six points, 9 emotional questions that are worth thirty-six points, and 7 physical questions that worth twenty eight points (Jacobson & Newman, 1990). It has a maximum score of 100 indicating a greater perceived handicap due to dizziness, and a minimum score of zero (Jacobson & Newman, 1990). The DHI responses are graded as 0 for "no", 2 for "sometimes", and 4 for "yes". According to Whitney et al, 2004 cut off scores for the DHI in people with a variety of vestibular disorders with a mean age of 61 are: 0-30 "Mild handicap", 31-60 "Moderate handicap", and 61-100 "Severe handicap" (S. L. Whitney, Wrisley, Brown, & Furman, 2004). The DHI was found to have excellent test-retest reliability for the total score (r=0.97) and subscales scores (r=0.92) (Jacobson & Newman, 1990). The internal consistency of the DHI is excellent for the total score (α=. 89) and adequate to excellent internal consistency for the subscales (α=. 72-. 85) (Jacobson & Newman, 1990). There is an adequate association between the score on the DHI and the number of dizziness episodes per year, which provides evidence for discriminant validity (Jacobson & Newman, 1990). In addition, there is evidence for adequate to excellent association between scores of the DHI and the short form 36 (SF-36) (r= 0.53 to 0.72), and between the DHI and the vestibular activities and participation scale (VAP) (0.54 to 0.74) demonstrating the convergent validity of the DHI (Alghwiri et al., 2012) (Fielder, Denholm, Lyons, & Fielder, 1996). The DHI is responsive to change as an outcome measure in vestibular rehabilitation (Enloe & Shields, 1997). In a study done on people with acute vestibular neuritis, they found an association between poor clinical outcomes (measured by DHI) and greater dependence on visual inputs for spatial orientation (Cousins et al., 2014).

2.6.2 The Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a 9-item self-report questionnaire that was developed to diagnose both the presence of depressive symptoms and characterize the severity of the depression (Spitzer et al., 1999). The PHQ-9 items are scored using a 4-point scale based on frequency of occurrence over the previous two weeks. The response scale used in the PHQ-9 is “not at all/several days/more than half the days/nearly every day” scored as “0/1/2/3” respectively. As a severity depression measure, the PHQ-9 score ranges from 0 to 27. A PHQ-9 score of “5, 10, 15, and 20” represents “mild, moderate, moderately severe and severe depression” (Kroenke, Spitzer, & Williams, 2001). The PHQ-9 was found to have excellent internal consistency (α=. 86-. 89) and excellent test retest reliability (r= .84) (Kroenke et al., 2001).

The PHQ-9 (Spitzer et al., 1999), Beck Depression Inventory (BDI) (Beck, Steer, Ball, & Ranieri, 1996) and the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) are used to record depression severity. They are all reliable, valid and responsive to change. The advantage of the PHQ-9 is that it is shorter and is based on the diagnostic criteria for depression giving it an advantage over the other depression measures (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; Cameron, Crawford, Lawton, & Reid, 2008; Titov et al., 2011).

2.6.3 The Patient Health Questionnaire (PHQ-15)

The PHQ-15 is a 15-item self-report somatic symptoms subscale that is useful in screening for somatization and in monitoring somatic symptom severity that was derived from the full Patient Health-Questionnaire (Kroenke et al., 2002; Spitzer et al., 1999). These 15 items screen for the most prevalent 15 somatic symptoms that are claimed to represent over 90% of physical complaints that are reported in outpatient settings (exclusive of self-limited upper respiratory symptoms) (Kroenke, 2003). In 13 of these items, subjects are asked to rate the severity of their symptoms and are scored using a 3-point scale and the response scale used is “not bothered at all, bothered a little, bothered a lot” scored as “0/1/2” respectively (Kroenke et al., 2002). The last 2 items - feeling tired or having little energy, and trouble sleeping – are from the depression module (i.e. contained in the PHQ-9) asking about physical symptoms (Kroenke et al., 2002). As a somatization severity symptom measure, the PHQ-15 score ranges from 0 to 30 with a higher score indicating high levels of somatic symptom severity (Kroenke et al., 2002). Scores of “5, 10, and 15” represent cut points for “low, medium, and high” somatic symptom severity respectively (Kroenke et al., 2002). The PHQ-15 has good reliability (α =0.82) and validity in assessing somatic symptoms in different health care settings (Kroenke, Spitzer, Williams, & Lowe, 2010).

Somatization is one of the most common issues in clinical practice, and has been found to be associated with functional impairment (Korber, Frieser, Steinbrecher, & Hiller, 2011; Steinbrecher, Koerber, Frieser, & Hiller, 2011). The PHQ-15 is relatively brief, reliable and valid measure that has been used for assessing somatic symptoms in psychiatric and primary care settings (Mewes, Rief, Brahler, Martin, & Glaesmer, 2008).

2.6.4 The Generalized Anxiety Disorder 7-item (GAD-7) Scale

The GAD-7 scale is a patient self-report that was developed to identify people with general anxiety disorder (GAD) and to assess symptom severity (Spitzer et al., 2006). The GAD-7 consists of 7 items and the response scale used is “not at all/several days/more than half the days/nearly every day” scored as “0/1/2/3” respectively with scale score ranging from 0 to 21. The GAD-7 was found to have excellent internal consistency (α=. 92), and good test-retest reliability (ICC=. 83) (Spitzer et al., 2006). The correlation between the GAD-7 and the Beck Anxiety Inventory was r=. 72 and the anxiety subscale of the Symptoms Checklist-90 was r=. 74 demonstrating convergent validity (Spitzer et al., 2006). A strong association was found between increasing GAD-7 severity scores and worsening function on all 6 dimensions of the Medical Outcomes Study Short Form General Health Survey SF-20. Patients with higher GAD-7 scores had a substantial stepwise decline in functioning in all 6 SF-20 domains (Spitzer et al., 2006). A GAD score of 10 or more is a reasonable cut point for identifying those with GAD (Spitzer et al., 2006).

Hence, the GAD is a powerful and short self-report measure that helps in identifying those with general anxiety disorders. Having any of the major anxiety disorders could alter an individuals' experience of space-motion perception and gait (Staab, Balaban, & Furman, 2013). As a result, there is no need to rate one type of anxiety favorably over another, except that health anxiety is found to be related to disability predictions (Hadjistavropoulos, Asmundson, & Kowalyk, 2004).

2.6.5 The Tampa Scale of Kinesiophobia

Kinesiophobia is defined by the developers as “an irrational and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or re-injury” (Kori SH, 1990). The Tampa Scale of Kinesiophobia **(**TSK) is a 17-item self-report questionnaire that was developed in order to measure fear of movement or re-injury and it is very helpful in measuring disabling beliefs about pain in people with chronic pain. The TSK items are scored using a 4-point Likert scale ranging from strongly disagree to strongly agree. Internal consistency of TSK ranges from (α =. 70-.83), and test-retest reliability ranges from r=0.64 to 0.80 (Swinkels-Meewisse EJ, 2003). The scale was developed based on the fear avoidance model, fear of work related activities, movement, and re-injury (Vlaeyen, Kole-Snijders, Boeren, et al., 1995). The TSK is also associated with elements of catastrophic thinking (Burwinkle, Robinson, & Turk, 2005) which was found to be linked to anxiety (Weinman J., 1996) and anxiety can lead to fear development (Yardley, 1994) which is the focus of our project.

2.6.6 The Fear Avoidance Beliefs Questionnaire (FABQ)

The Fear-Avoidance Beliefs Questionnaire (FABQ) is a 16-item self-report questionnaire that measures patients' fear of pain and avoidance of physical activity as a result of their fear (Fritz & George, 2002; Waddell et al., 1993). The FABQ items are scored using a 6-point Likert scale with higher scores indicating greater fear and avoidance beliefs (Waddell et al., 1993). The questionnaire was developed based on the fear-avoidance theories that focus on the patients' beliefs and exaggeration of pain perception and how physical activity and work both affect their low back pain (Waddell et al., 1993). The theory was created in order to explain why some patients with acute pain recover and others develop chronic pain conditions (Fritz & George, 2002; Lethem et al., 1983; Waddell et al., 1993). The FABQ was found to have excellent test retest reliability (ICC=0.97) (Williamson, 2006). A good correlation was found between the FABQ, the Roland and Morris Disability Questionnaire, and the Tampa Scale of Kinesiophobia demonstrating convergent validity (Williamson, 2006).

The FABQ assesses patients' beliefs about what it means to have symptoms and still function on a daily basis. There are also questions about compensation status (Social Security benifits), which is known to predict disability (Breivik, Nilsen, Myrseth, Finnkirk, & Lund-Johansen, 2013). For the abovementioned reasons, we decided to adapt the original FABQ questions to the construct of dizziness to determine if any of the items were valuable for our newly developed measure.

2.6.7 The Short Health Anxiety Inventory (SHAI)

The SHAI is a patient self-report scale that was derived from the full HAI questionnaire in order to assess health anxiety independently of physical health status (i.e. to maintain specificity between those who have health anxiety and those with other anxiety disorders and persons who were physically ill) (Salkovskis et al., 2002). The SHAI consists of 14 items that assess worry about health, awareness of any bodily sensations or changes, and feared consequences of having an illness. The SHAI has demonstrated good internal consistency (α=. 89) and test retest reliability (r=. 90), criterion validity, and sensitivity to treatment (Salkovskis et al., 2002). Items are scored as “0/1/2/3” with the scale score ranging from 0 to 42.

The SHAI is a short self-report measure that assesses health anxiety and health anxiety appears to predict disability (Hadjistavropoulos et al., 2004).

2.6.8 The Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS is a 12-item self-report questionnaire that was developed in order to make a distinction between perceived social support from three specific sources: family, friends, and a significant other (Zimet et al., 1988). The MSPSS consists of four items for each social support group. Responses utilize a 7-point Likert-type scale and are graded as 1 for “Very Strongly Disagree”, 2 for “Strongly Disagree”, 3 for “Mildly Disagree”, 4 for “Neutral”, 5 for “Mildly Agree”, 6 for “Strongly Agree”, and 7 for “Very Strongly Agree”. In the original study (Zimet et al., 1988), the MSPSS was found to have good test-retest reliability for total score (r=0.85) and subscales scores (r=0.85), (r=0.75), and (r=0.72) for the family, friends, and significant other subscale respectively. The MSPSS showed moderate construct validity with subscale scores correlating with measures of depression and anxiety.

Social support is a multidimensional concept that is integral to an individual's physical and psychological well-being (Hardan-Khalil & Mayo, 2015). High levels of anxiety and depression were associated with low perceived social support (Zimet et al., 1988). It is important to use a well-tested instrument that measures social support and demonstrates reliable and valid data.

In order to determine which items from the above mentioned scales are most important to predict outcomes in persons with vestibular disorders, a systematic process can be utilized to determine which of the above individual items are important. The Delphi technique was developed to determine which specific test items might have value based on expert opinion.

2.7 THE DELPHI TECHNIQUE

The Delphi is an interactive method developed by the RAND Corporation (Santa Monica, California) in the 1950's (Williams & Webb, 1994). The rationale for the procedure was to develop a technique to elicit the most reliable consensus from a group of experts (Norman Crolee Dalkey, Brown, & Cochran, 1969).

The Delphi method has four main characteristics: anonymity, iteration, controlled feedback, and statistical group response. Anonymity to respondents can be achieved by the use of a formal questionnaire to obtain experts' opinions. Anonymity in the Delphi process is an essential characteristic for many reasons. The Delphi technique prevents dominance of panelist members because all participants are anonymous. Additionally, unlike group meetings anonymity eliminates the unnecessary impact of ranking, power and persuasive speaking (Westbrook, 1997). Compared to other data collection and analysis techniques, the Delphi employs multiple iterations over two or more rounds that allow experts to change their opinion and develop a consensus concerning a specific topic. This can minimize group pressure for conformity and ensure that each experts' responses are well represented in the final round (N. C. Dalkey, 1972).

Another characteristic of using the Delphi technique is controlled feedback. Controlled feedback entails a summary of the previous rounds group responses distributed to all panelists which gives the participants an opportunity to have additional insights through the information developed by the prior round. Controlled feedback attempts to reduce "noise" that happens as a result of communication in a group process. Group discussion can sometimes mislead the data as a result of focusing on dealing with group and/or individual interests instead of problem solving. This can bias the information gathered by this kind of communication that is not related to the purpose of the study (N. C. Dalkey, 1972).

Many researchers have applied the Delphi technique in their studies in different fields for a wide variety of purposes in order to achieve consensus opinion. Alghwiri et al. used seventeen national and international experts in order to develop and validate the Vestibular Activities and Participation (VAP) measure for people with vestibular disorders according to the International Classification of Functioning, Disability and Health (ICF) (Alghwiri et al., 2012). Maarsingh et al. used a group of 16 experts in the field of dizziness in the development of a diagnostic protocol for dizziness in an older population in primary care practice (Maarsingh et al., 2009).

The number of rounds used in the Delphi procedure is variable, however, two to three rounds are usually sufficient for most research (Stevens et al., 2006). Also, as the number of rounds and effort increases, one often sees a fall in the response rate. The Delphi technique can be used with a variety of objective and impartial statistical analysis techniques in order to interpret and summarize the collected data.

3.0 THE DEVELOPMENT OF THE VESTIBULAR ACTIVITIES AVOIDANCE INSTRUMENT USING THE DELPHI TECHNIQUE

Two studies were conducted in order to develop and validate the Vestibular Activities Avoidance Instrument. In the first study, we used a list of 111 candidate items to obtain experts' agreement on the items to be included in the Vestibular Activities Avoidance Instrument using the Delphi technique. The list of candidate items was retrieved from eight valid and reliable self-report instruments. The results of the Delphi technique were discussed among the research group and the included items, the stem question and the response scale for the developed measure were determined. Finally, we examined the reliability (test-retest) of the newly developed Activities Avoidance Measure. In the second study, we examined validity and established psychometric properties of the Activities Avoidance Measure in people with balance and vestibular disorders. The two studies are discussed in detail below.

3.1 OVERALL METHOD

Based on consensus of 5 experts (1 psychiatrist, 3 physical therapists, and 1 neurologist) in vestibular rehabilitation, 111 items were selected from eight valid and reliable instruments including the Dizziness Handicap Inventory (DHI) (Jacobson & Newman, 1990), the Patients Health Questionnaire (PHQ-9) (Spitzer et al., 1999), the Patients Health Questionnaire (PHQ-15) (Kroenke et al., 2002; Spitzer et al., 1999), the Generalized Anxiety Disorder Assessment (GAD-7) (Spitzer et al., 2006), the Tampa Scale of Kinesiophobia (TSK) (Kori SH, 1990), the Fear Avoidance Beliefs Questionnaire (FABQ) (Fritz & George, 2002; Waddell et al., 1993), the Short Health Anxiety Inventory (SHAI) (Salkovskis et al., 2002), and the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1988).

The development of the Vestibular Activities Avoidance Instrument (VAAI) was accomplished by determination of experts' agreement on the items to include by using the Delphi technique.

A group of 24 national and international experts (United States, South America, United Kingdom, Australia, Canada, Japan, Turkey, South Korea, Sweden, and Germany) in vestibular disorders were selected by three of the research group. Percentage of agreement per each item was calculated. The inclusion criterion for an item to be included in the VAAI was $\geq$ 70% agreement.

Individuals with vestibular disorders between the ages of 18 and over with dizziness and imbalance complaints who speak English and provided informed consent were included in the study. Additionally, individuals were excluded if they were unable to complete the questionnaires because of cognitive barriers or if an acute medical condition was associated with dizziness and required immediate attention (e.g. acute myocardial infarction or stroke). Patients were asked to complete the newly developed questionnaire, two disability questions and the SF-12 during their initial visit to the University of Pittsburgh Medical Center Eye and Ear Institute.

The patients had to complete the VAAI twice in the same day for test-retest reliability before they saw the neurologist.

The two disability questions used were: 1) on how many days in the last two weeks did you miss scheduled activities completely because of your dizziness? 2) On how many days in the last two weeks did you participate in scheduled activities, but were limited because of your dizziness? Subjects had to choose from (0-14) days for each of the following categories: at work, at home/with family, and in social or community events.

3.2 INTRODUCTION

Dizziness, vertigo, and imbalance are considered to be among the most frequent complaints in medical practice globally and in the United States especially for those with vestibular deficits (Agrawal et al., 2009; Jonsson et al., 2004; Kerber et al., 2006). According to several international studies, dizziness may impact approximately one quarter of the population over the age of 40 (Agrawal et al., 2009). Dizziness and vertigo are also marked complaints in emergency settings in Europe (Karatas, 2008).

Vestibular disorders result in physical and psychological consequences that have significant impact on individuals' activities of daily living (ADL) and their overall quality of life (QOL) (Mira, 2008; White et al., 2005). Hence, vestibular disorders contribute to placing burden on individuals, the economy, health care and individuals' disability (Gamiz & Lopez-Escamez, 2004; Mira, 2008). The physical consequences of vestibular disorders which lead to individual disability include unsteadiness, imbalance, and falls (Agrawal et al., 2009). Agoraphobia, panic disorders, anxiety, and depression are all psychological sequelae that have been reported by 50% of people with vestibular disorders (Yardley, Owen, Nazareth, & Luxon, 2001) that may impact outcome.

As a result of these negative consequences, some people with vestibular disorders tend to avoid activities, limit movement and avoid specific circumstances because of their fear of provoking symptoms, unanticipated dizziness, or unsteadiness (Mira, 2008; Yardley & Redfern, 2001). These activities and environments are very important in facilitating compensation, and avoiding them contributes to disability (Yardley & Redfern, 2001). Consequently, fear of unpleasant provoking symptoms impacts an individuals' function and productive work life (White et al., 2005).

There are several self-report measures that quantify the impact of dizziness on daily life, and measure the disabling consequences of vertigo on activities of daily living (ADL), social life, and leisure (Jacobson & Newman, 1990);(H. S. Cohen & Kimball, 2000; J. E. Ware, Jr. & Sherbourne, 1992; Yardley & Putman, 1992). However, none of these instruments were designed to identify those who avoid activities as a result of their fear of a dizziness episode. Therefore, a specialized instrument is needed to help clinicians and researchers identify individuals with vestibular and balance disorders who may avoid activities in order to prescribe an appropriate intervention.

3.3 METHODS

The development of the Vestibular Activities Avoidance Instrument was accomplished by determination of experts' agreement on the items to include in the newly developed measure using the Delphi technique.

3.3.1 Phase 1: The Development of the VAAI

3.3.1.1 Establishment of a list of possible Activities Avoidance items

Eight valid and reliable instruments were used to establish the Activities Avoidance questionnaire including the Dizziness Handicap Inventory (DHI) (Jacobson & Newman, 1990), the Patient Health Questionnaire (PHQ-9) (Spitzer et al., 1999), the Patient Health Questionnaire (PHQ-15) (Kroenke et al., 2002; Spitzer et al., 1999), the Generalized Anxiety Disorder Assessment (GAD-7) (Spitzer et al., 2006), the Tampa Scale of Kinesiophobia (Kori SH, 1990), the Fear Avoidance Beliefs Questionnaire (FABQ) (Waddell et al., 1993), the Short Health Anxiety Inventory (SHAI) (Salkovskis et al., 2002), and the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1988). Selecting the instruments was based on consensus of five experts in vestibular rehabilitation including 1 psychiatrist, 2 physical therapists, 1 epidemiologist physical therapist and 1 neurologist.

3.3.1.2 Study participants

A group of 24 national and international experts on vestibular disorders was selected by three of the research group (S.W., J. F. and J.S.). The experts (representing physical therapy, otolaryngology, neurology, psychiatry, occupational therapy, and physical medicine) were invited to participate in the Delphi procedure by an individual e-mail invitation in order to maintain anonymity explaining the study procedure and its rationale. Selection of experts was based on level of expertise and knowledge in the field of vestibular dysfunction. Experts who showed a willingness to participate in the study were sent a web link to the survey via an email that was sent to each expert individually.

3.3.1.3 Determination of experts' agreement

Qualtrics ™ an (internet-based survey) was used to obtain experts' agreement on the list of activities avoidance candidate items that were generated in round 1 of the Delphi technique. The Delphi is an interactive method used to elicit the most reliable consensus from a group of experts that has many advantages over other ways of reaching consensus such as group meetings or discussion (Norman Crolee Dalkey et al., 1969). The Delphi method encourages honest opinion and eliminates unnecessary impact of ranking, power and persuasive speaking that insures achieving consensus of experts' opinions without the bias that can occur in other techniques (Madelon L Petersa, 2000).

3.3.1.4 The Delphi process

The potential questions were administered via an internet-based survey. In the first round, our panel of experts received a web link for the 111 possible activities avoidance items (Refer to Table 1 for all the 111 items) in order to obtain experts' consensus on the items to be included in a new outcome self-report measure that identifies those with vestibular and balance disorders who may avoid activities. The response scale that was used in the survey in order to determine the experts' opinion regarding the inclusion/exclusion of the potential items was a 3-point verbal response scale (definitely include, possibly include, definitely do not include). Table 3 is an example of a portion of the survey.

In the second round, all items were presented to all experts again and each expert received information about the percentage of agreement for each potential item in the first round and their own response compared with the group score. Participants were given an opportunity to modify their responses based on this information and indicate a new response if they decided to modify their response. The research team determined that an additional iteration was needed since nine items nearly reached the 70% agreement (60-65%) to be included in the new measure, and a third round was administered (Alghwiri et al., 2012; Maarsingh et al., 2009).

In the third round, all items were presented to all experts again along with the percentage of agreement for each candidate item in the second round and their own response compared with the group score. The participants had to indicate for each item whether it should be incorporated in the new self- report measure or not. Participants were permitted to change their score in view of the group's response.

We scheduled five weeks for each Delphi round, the first four weeks to allow the participants to complete the survey and submit it, and one week to interpret the responses and to re-send them back to our experts for additional input.

3.3.1.5 Data analysis

Analysis of experts' agreement from the first, second and third rounds was conducted and the percentage agreement per item was calculated. The percentage of agreement was obtained by dividing the number of ratings in agreement by the total number of ratings, and then converting the fraction into a percentage. For each item, the scores were divided into 2 categories: “inclusion” and “exclusion”. The percentage of agreement of the first response: “This item should definitely be included in the measure” represented “inclusion”. The percentage of agreement of the last response: “Definitely do not include this item” represented “exclusion”. The items that had 70% agreement or more were included in the VAAI. There is no universal agreed percentage of the level of consensus to use with the Delphi technique; it is usually up to the authors’ judgment (Hasson, Keeney, & McKenna, 2000). We chose “70%” as the agreement criteria for inclusion in order to obtain a rigorous estimation of the items that most experts agree to have in the new measure (Alghwiri et al., 2012; Maarsingh et al., 2009).

3.3.1.6 Consensus meeting

A meeting was held to finalize the development of the Vestibular Activities Avoidance Instrument. The results of the three rounds of the Delphi technique were examined and the items to include in the Activities Avoidance Scale were determined. Furthermore, the research group generated the stem question and the response scale to be used with the newly developed measure. The stem of the VAAI was “Due to your dizziness/unsteadiness, how much do you agree with each statement below?”. A 7-points likert scale indicating level of agreement with each item of the VAAI was used: strongly disagree=1, disagree=2, somewhat disagree=3, neutral=4, somewhat agree=5, agree=6, and strongly agree=7. The total score of the VAAI was computed by summing up items responses values. A higher score (worse) indicates more fear avoidance behavior. Appendix A represents the VAAI.

3.3.1.7 Pre testing

The questionnaire was first tested on a small representative sample (n=10) of people with vestibular disorders. Subjects were asked to complete the instrument and then answer some questions in order to identify problems with item content. The subjects were asked the following questions: Was the questionnaire easy to follow? Which items, if any, were confusing? Why? Was it easy to read? Was it easy to understand the directions? What sections or items were most difficult? Why? Were questions unclear or misleading? Feedback to these questions can greatly improve the questionnaire's design, item format and flow. Patients' inputs were taken into consideration in order to improve clarity of the content. The data of these 10 subjects were just used in the construction of the VAAI.

3.3.2 Phase 2: The Reliability and Validity of the VAAI

3.3.2.1 Reliability

Participants

A convenience sample of individuals with vestibular disorders ages 18 and over with dizziness and imbalance complaints who were referred to a neuro-otologist at the University of Pittsburgh Medical Center was utilized. The biomedical institutional review board approved the study, and all participants provided informed consent.

Procedures

Participants were asked to complete the VAAI (77 items) during their initial visit. On the same day, a second VAAI with questions in a different order in order to minimize recall bias was given to the participants at least 45 minutes after completing the first VAAI and before they saw the neurologist in order to insure that their condition was stable during the test-retest interval.

Test-retest reliability of the total scores for two initial administrations of the VAAI was estimated using an intraclass correlation coefficient (ICC 3, 1). The Two-way mixed model, ICC (3,1) was used here because raters (subjects) are considered as fixed effects (no generalization beyond the sample at hand) and the application was based on a single measurement (Shrout PE, 1979). An ICC of >.75 indicates "excellent" reliability, .40-.74 indicates "fair to good" reliability, and <. 40 indicate "poor" reliability (Shrout PE, 1979). Agreements between subject ratings on successive test administrations for individual items were estimated using quadratic weighted kappa.

The standard error of the measurement (SEM) and the minimal detectable change at 95% confidence level (MDC) were calculated for the VAAI. The SD that was used to compute SEM is the SD of the first administration of the VAAI. The MDC95 can be interpreted as the magnitude of change needed to conclude that real change occurred with 95% confidence. The MDC95 and SEM were calculated using the following formulas (Haley & Fragala-Pinkham, 2006):

$$\text{SEM} = \text{SD} \times \sqrt{1\text{-ICC}}$$

$$MDC = SEM \times \sqrt{2} \times 1.96$$

Content validity

Content validity defines the degree to which the items of the measurement instrument adequately reflect the construct to be measured. Our Delphi experts judged which items to be included in the instrument depending on their relevance and comprehensiveness. Moreover, the research group examined the results of the Delphi and decided to add more items that they felt were essential to cover all aspects of avoidance behavior. This helped in ensuring the content validity of the VAAI

Convergent validity

Convergent validity was assessed by computing the Spearman rank order correlation coefficients (*rho*) between the VAAI and the SF-12 and the disability questions. A Spearman correlation coefficient of ≥ 0.60 indicates strong correlation, 0.31-0.59 indicates moderate correlation, and ≤ 0.30 indicates poor correlation (EM, 2000).

Discriminant validity

In order to examine the contribution of the sample characteristics on the VAAI score, the Mann-Whitney U test for 2 independent samples was used for categorical variables (gender, diagnosis, and self-reported imbalance) and the non-parametric Spearman rank order correlation (*rho*) for continuous variables (age, duration of symptoms, and number of medications).

Internal consistency

Internal consistency of the resultant scale was estimated using Cronbach's alpha (α). Value of >0.70 is required in order to demonstrate that the items are sufficiently correlated (Nunnally J, 1994).

3.3.2.3 Reliability and Validity Data Analysis

SPSS version 24 and Microsoft Excel 2011 for Mac version 14.6.1 were used for the statistical analysis of the descriptive data, the total score test-retest reliability, and to calculate the weighted kappa statistics for item agreement.

4.0 RESULTS

4.1 PHASE 1: THE DEVELOPMENT OF THE VAAI

4.1.1 4.1 Establishment of a list of possible Activities Avoidance items

Eight current, valid and reliable instruments were used to establish the Vestibular Activities Avoidance Instrument. Additionally, five more items were added by an expert in vestibular rehabilitation (S.W.) at the expert consensus face-to-face meeting. The five items that the expert thought were important were "Taking medication will make me better; exercise will make me feel better; movement of my head makes me feel sick; exercising at home without supervision makes me feel worse; and going to certain places, like grocery stores, makes me feel worse". After removing redundant items and combining some items because of item similarity, one hundred and eleven items remained (Table 1).

4.1.2 Determination of experts' agreement

Twenty-four experts agreed to participate in the Delphi study: Nine experts were from the United States (37.5%), 6 from South America (25%), 2 from the United Kingdom (8%), 1 from Australia (4.2%), 1 from Canada (4.2%), 1 from Japan (4.2%), 1 from Turkey (4.2%), 1 from South Korea (4.2%), 1 from Sweden (4.2%), and 1 from Germany (4.2%). Twenty participants completed the first round survey: 8 physical therapists (33.3%), 7 otolaryngologists (29.2%), 5 neurologists (21%), 2 psychologists (8.3%), 1 rehab physician (4.1%), and 1 occupational therapist (4.1%). No additional items were recommended by any of the participants. Seventeen out of the twenty participants completed the second round survey (85% response rate). Eighteen participants completed the third round of the survey (90% response rate). A response rate of 70% must be preserved in order to maintain the precision of the results of the Delphi technique (Hasson et al., 2000). The non-responders for round two were two neurologists and a physical therapist and for round three, two neurologists did not complete the survey.

The first round of the Delphi procedure resulted in the inclusion of 20 items that had 70% or more agreement and the exclusion of 7 items. After the second round, twenty-four items had 70% or greater agreement to include in the new measure and twelve items were excluded. The third round resulted in inclusion of thirty-four items and seventeen excluded items on which no agreement could be reached. In total, thirty-four items were included after three rounds of the Delphi polling (Table 1). Furthermore, the VAAI development committee added another 43 items to reach a total of 77 items (see section 4.1.3).

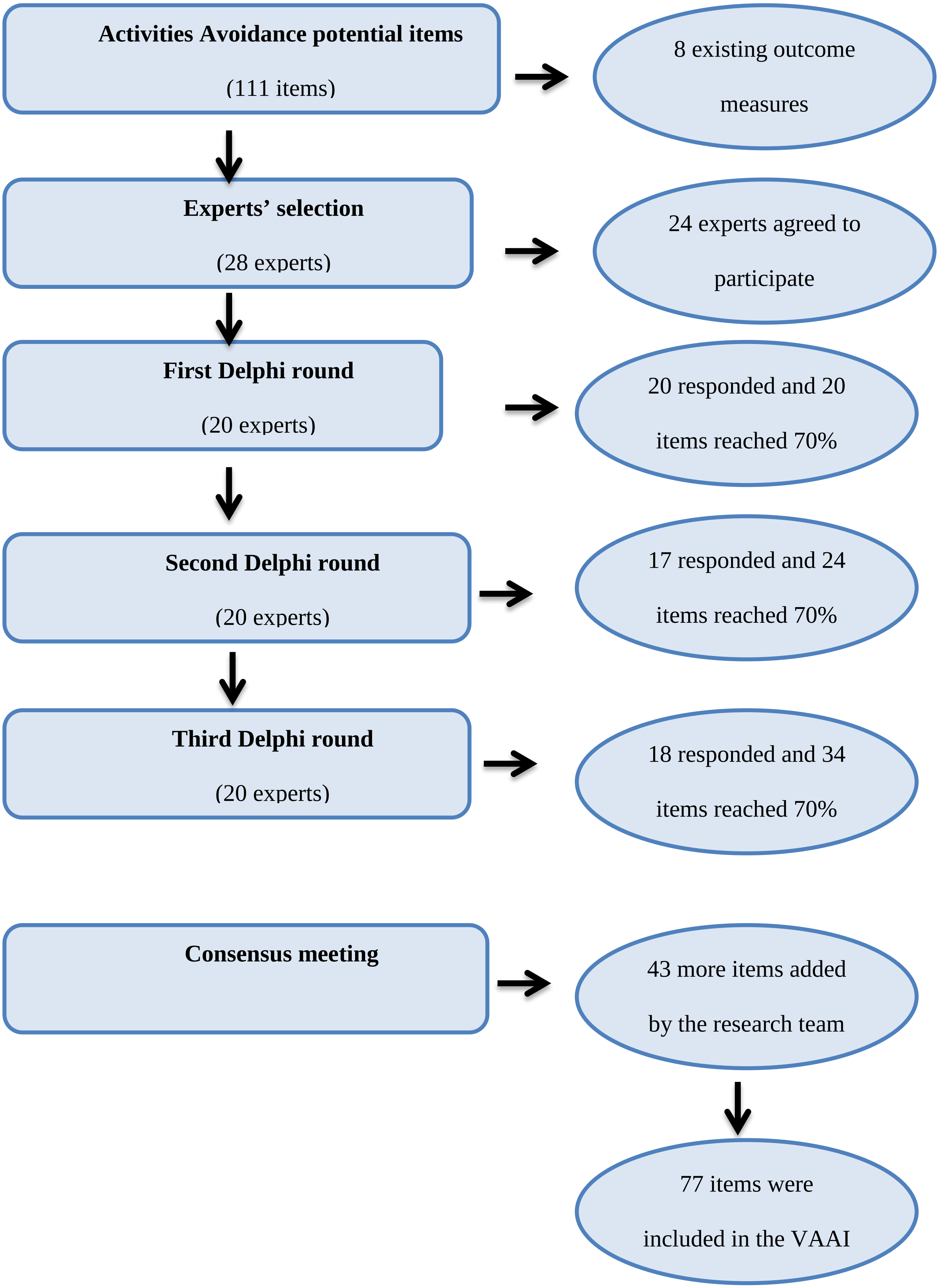

Figure 3. A flowchart of the Delphi results

Table 1. The results of round 1, 2, and 3 of the Delphi technique. The percentages represent the number of the Delphi panel experts who marked "definitely include" for the item.

*****Bold numbers represent items that was included in the VAAI

Item	First round	Second round	Third Round
1. During the last 4 weeks, I have been bothered by dizziness/unsteadiness.	60%	75%	**80%**
2. My dizziness/imbalance was caused by physical activity.	50%	55%	**70%**
3. During the last 4 weeks, I have been bothered by stomach pain.	0%	0%	0%
4. Does walking down a sidewalk increase your dizziness/unsteadiness?	35%	35%	**25%**
5. I worry about my health much of the time.	40%	45%	**65%**
6. If I notice a body sensation that I cannot explain, I often find it difficult to think of other things.	30%	25%	**10%**
7. During the last 4 weeks, I have been feeling nervous, anxious or on edge.	50%	65%	**70%**
8. Physical activity makes my dizziness/unsteadiness worse.	75%	75%	**90%**

Table 1 (continued)

9. Because of your problem, do you feel frustrated?	35%	35%	**20%**
10. During the last 4 weeks, I have been feeling down, depressed, or hopeless.	50%	65%	**75%**
11. I'm afraid that I might make myself dizzy or unsteady if I exercise.	70%	68%	**75%**
12. Because of your dizziness/ unsteadiness, is it difficult for you to concentrate?	50%	55%	**60%**
13. Does looking up increase your dizziness/unsteadiness?	80%	78%	**85%**
14. If I were to try to overcome it, my dizziness/unsteadiness would increase.	35%	35%	**35%**
15. My work might make my dizziness/unsteadiness worse.	55%	60%`	**65%**
16. My body is telling me I have something dangerously wrong.	25%	20%	**15%**
17. Because of your dizziness/unsteadiness, do you restrict your travel for business or recreation?	90%	95%	**95%**
18. During the last 4 weeks, I have had pain in my arms, legs, or joints (knees, hips, etc.).	15%	10%	10%
19. I should not do physical activities which (might) make my dizziness/unsteadiness worse.	75%	70%	**80%**
20. Because of your dizziness/unsteadiness, is it difficult for you to walk around your house in the dark?	70%	75%	**90%**

Table 1 (continued)

21. During the last 4 weeks, I have had little interest or pleasure in doing things.	50%	55%	**65%**
22. I cannot do physical activities which (might) make my dizziness/unsteadiness worse.	65%	65%	**65%**
23. My dizziness/unsteadiness would probably be relieved if I were to exercise.	30%	15%	**5%**
24. During the last 4 weeks, I have not been able to stop or control worrying.	35%	40%	**40%**
25. Does walking down the aisle of a supermarket increase your dizziness/unsteadiness?	80%	80%	**85%**
26. I notice dizziness and unsteadiness more than most people my age.	30%	30%	**30%**
27. People aren't taking my medical condition seriously enough.	35%	35%	30%
28. Because of your dizziness/unsteadiness, are you afraid to stay home alone?	30%	20%	**20%**
29. Having dizziness/unsteadiness always means I have injured my body.	25%	10%	10%
30. My dizziness/unsteadiness was caused by my work or by an accident at work.	35%	40%	**40%**
31. I believe that I have a serious illness much of the time.	40%	50%	**50%**
32. My injury has put my body at risk for the rest of my life.	25%	20%	**15%**
33. Because of your dizziness/unsteadiness, do you have difficulty getting into or out of bed?	70%	80%	**85%**

Table 1 (continued)

34. My work aggravated my dizziness/unsteadiness.	55%	65%	**70%**
35. During the last 4 weeks, I have been feeling tired or having little energy.	20%	10%	**5%**
36. Because of your dizziness/unsteadiness, do you feel handicapped?	45%	40%	**35%**
37. During the last 4 weeks, I have had trouble falling or staying asleep, or sleeping too much.	25%	30%	**30%**
38. I am aware of bodily sensation or changes much of the time.	30%	25%	**25%**
39. I have a claim for compensation for my dizziness/unsteadiness.	45%	65%	**70%**
40. Does your dizziness/unsteadiness significantly restrict your participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties?	95%	95%	**95%**
41. I feel that my risk for developing a serious illness is moderate.	15%	5%	5%
42. Just because something aggravates my dizziness/imbalance does not mean it is dangerous.	35%	30%	**30%**
43. Has the dizziness/unsteadiness placed stress on your relationships with members of your family or friends?	45%	50%	**55%**
44. I am afraid that I might make myself dizzy accidentally.	55%	65%	**70%**
45. My family members and friends would say that I worry too much about my health.	15%	15%	**5%**

Table 1 (continued)

46. During the last 4 weeks, I have had menstrual cramps or other problems with my periods.	0%	5%	5%
47. During the last 4 weeks, I have been feeling tired or having little energy.	20%	10%	10%
48. Because of your dizziness/unsteadiness, do you have difficulty reading?	65%	75%	**75%**
49. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my dizziness/unsteadiness from worsening.	70%	75%	**85%**
50. I try to resist thoughts of illness, but often cannot do it.	25%	30%	**25%**
51. Because of your dizziness/unsteadiness, are you depressed?	45%	60%	**65%**
52. My work causes too much dizziness/unsteadiness for me.	65%	70%	**80%**
53. I wouldn't have this much dizziness/unsteadiness if there weren't something potentially dangerous going on in my body.	25%	15%	5%
54. During the last 4 weeks, I have been worrying too much about different things.	20%	10%	**5%**
55. There is a special person who is around when I am in need.	10%	5%	0%
56. Does performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away? Increase your dizziness/unsteadiness?	75%	80%	**85%**

Table 1 (continued)

57. No one should have to exercise when he/she is dizzy.	40%	40%	**25%**
58. My work makes or would make my dizziness/unsteadiness worse.	55%	60%	**60%**
59. Does your dizziness/unsteadiness interfere with your job or household responsibilities?	75%	75%	**80%**
60. There is a special person with whom I can share my joys and sorrows.	5%	5%	0%
61. During the last 4 weeks, I have had pain or problems during sexual intercourse.	10%	5%	0%
62. During the last 4 weeks, I have had poor appetite or I am overeating.	5%	5%	0%
63. My family really tries to help me.	30%	15%	5%
64. Because of your dizziness/unsteadiness, are you afraid to leave your home without having someone accompany you?	80%	85%	**85%**
65. During the last 4 weeks, I have had constipation, loose bowels, or diarrhea.	0%	0%	0%
66. During the last 4 weeks, I have been feeling bad about myself — or that I am a failure or have let my family or myself down.	10%	10%	**5%**
67. Does bending over increase your dizziness/unsteadiness?	85%	85%	**95%**
68. I get the emotional help and support I need from my family.	15%	15%	**10%**
69. During the last 4 weeks, I have had trouble relaxing.	15%	15%	**15%**

Table 1 (continued)

70. I have a special person who is a real source of comfort to me.	5%	5%	0%
71. I should not do my regular work with my present dizziness/unsteadiness.	55%	60%	**65%**
72. Because of your dizziness/unsteadiness have you been embarrassed in front of others?	65%	65%	**70%**
73. My friends really try to help me.	5%	5%	5%
74. During the last 4 weeks, I have had headaches.	45%	50%	**60%**
75. I can count on my friends when things go wrong.	5%	5%	0%
76. I am afraid that I have a serious illness much of the time.	25%	15%	**5%**
77. During the last 4 weeks, I have been so restless that it is hard to sit still.	15%	10%	5%
78. I can talk about my problems with my family.	10%	10%	5%
79. I cannot do my normal work with my present dizziness/unsteadiness.	65%	70%	**85%**
80. Do quick movements of your head increase your dizziness/unsteadiness?	75%	80%	**85%**
81. I have mental images of myself being ill much of the time.	10%	10%	**5%**
82. Even though something is causing me dizziness/unsteadiness, I don't think it's actually dangerous.	25%	15%	**10%**
83. During the last 4 weeks, I have had chest pain.	10%	5%	5%

Table 1 (continued)

84. I have friends with whom I can share my joys and sorrows.	0%	0%	0%
85. I cannot do my normal work until my dizziness/unsteadiness is treated.	45%	55%	**70%**
86. There is a special person in my life who cares about my feelings.	5%	5%	5%
87. Because of your dizziness/unsteadiness, is it difficult for you to go for a walk by yourself?	80%	85%	**80%**
88. Because of your dizziness/unsteadiness, do you avoid heights?	75%	85%	**85%**
89. My family is willing to help me make decisions.	5%	10%	0%
90. I often have difficulty taking my mind off thoughts about my health.	20%	10%	**5%**
91. During the last 4 weeks, I have had fainting spells.	40%	50%	**55%**
92. Movement of my head makes me feel sick.	70%	75%	**85%**
93. During the last 4 weeks, I have been moving or speaking so slowly that other people could have noticed or the opposite - being so fidgety or restless that I have been moving around a lot more than usual.	10%	15%	15%
94. I can't do all the things normal people do because it's too easy for me to get dizzy/lose my balance.	70%	70%	**70%**
95. Does turning over in bed increase your dizziness/unsteadiness?	75%	80%	**95%**

Table 1 (continued)

96. During the last 4 weeks, I have become easily annoyed or irritable.	30%	20%	15%
97. During the last 4 weeks, I have been feeling my heart pound or race.	20%	15%	**15%**
98. I do not think that I will be back to my normal work within 3 months.	35%	30%	**30%**
99. If my doctor tells me that there is nothing wrong with my health, I am relieved at first, but worries always return later.	25%	20%	20%
100. It's really not safe for a person with a condition like mine to be physically active.	40%	45%	**40%**
101. During the last 4 weeks, I have had nausea, gas, or indigestion.	20%	20%	5%
102. Because of your dizziness/unsteadiness, is it difficult for you to do strenuous homework or yard work?	60%	70%	**75%**
103. If I hear about an illness, I often think that I have it myself.	20%	15%	10%
104. During the last 4 weeks, I have had shortness of breath.	5%	5%	**5%**
105. If I have a body sensation or change, I always wonder what it means.	20%	20%	15%
106. Dizziness/unsteadiness lets me know when to stop exercising so that I don't injure myself.	40%	45%	**50%**
107. Because of your dizziness/unsteadiness, are you afraid people may think you are intoxicated?	45%	50%	**55%**

Table 1 (continued)

108. Although physical activities may increase my symptoms, I would be better off if I were physically active.	50%	60%	**70%**
109. During the last 4 weeks, I have been feeling afraid as if something awful might happen.	20%	15%	**5%**
110. During the last 4 weeks, I have had thoughts that I would be better off dead or hurting myself in someway.	15%	15%	5%
111. I do not think that I will ever be able to go back to that work.	35%	35%	**30%**

4.1.3 Consensus meeting

The 34 items with 70% or more agreement after 3 rounds of the Delphi were included in the VAAI measure. In addition, the research group decided to include 9 items that nearly reached the 70% agreement (60-65%). In another consensus meeting the research team decided to add 34 more items that had less than 70% agreement (5-55%) to include in the VAAI because of the important information they might add so 77 items were included in the final tested version of the tool.

Subsequently, the following stem question was generated to use with the VAAI measure: "Due to your dizziness/unsteadiness, how much do you agree with each statement below". Finally, the response scale of the VAAI measure was set as a 7-point scale indicating the level of agreement: strongly disagree=1, disagree=2, somewhat disagree=3, neutral=4, somewhat agree=5, agree=6, and strongly agree= 7 (Table 2).

4.1.4 Pre testing

Ten subjects with vestibular disorders were asked if they had any difficulty with the items or any suggestions for rewording. Taking into consideration the comments of the participants, in item "73" the word "injury" was changed to "illness", in item "75" the word "have" was changed to "should", and in item "71" the word "it" was changed to my dizziness/imbalance in order to improve clarity of the statements.

4.2 PHASE 2: THE RELIABILITY AND VALIDITY OF THE VAAI

4.2.1 Participants

A total of 106 subjects were recruited; however, 1 subject withdrew from the study for an unknown reason. A description of the characteristics of the 105 subjects is presented in Table 2. A hundred and five subjects participated in this study including 61 females (58%) and 44 males (42%) with an average age of 52.6 y (SD 14.2 y, range 21-82 y). Duration of dizziness and/or imbalance symptoms reported by subjects ranged between <1-40 years (median 1 year). The number of medications used reported by subjects ranging from 0 to 25 with a median of 6. Thirty-six subjects (34%) reported balance difficulties and 36 subjects reported falls. Sixteen had vestibular dysfunction with central involvement (15%), 59 had peripheral vestibular disorders (56%), 21 had unspecified dizziness (20%), and 2 subjects had mixed central and peripheral involvement (2%). Specific diagnoses are presented in Table 3.

Normality of the VAAI total score was tested using Shapiro-Wilk test. The VAAI total scores met the normality assumption (p=.16). A Shapiro-Wilk's test (p>.05) and a visual inspection of the VAAI histogram, normal Q-Q plot, and box plots showed that the VAAI scores werer normally distributed and there was no evidence of outliers (Figure 4, 5, and 6). The mean of the VAAI , physical and mental component score of the SF-12 are presented in Table 3.

After visually inspecting the raw data, more subjects in the higher quartile of the VAAI had a history of anxiety compared to the other three quartiles. Fifty-two percent of the subjects in the highest quartile group had anxiety (n=13), compared to 20% with anxiety (n=5) in the lowest quartile, 24% (n=6) in the second quartile, and 12% (n=3) in the third quartile (Figure 7). We found a significant relationship between quartiles and anxiety (p =. 01). In order to examine the direction of this relationship, we performed proportion analysis and found that the proportion of subjects with anxiety in the highest quartile of the VAAI was statistically significantly higher (52%) than those at the lower quartiles (19%), z=3.25, $p<.001$ (Figure 8). We found no significant relationship between quartiles and depression (p=. 6) (Figure 9), however, the proportion of subjects with depression in the highest quartile of the VAAI was higher (48%) than those at the lower quartiles (32%), but this was not statistically significant, z=1.44, $p=.1$ (Figure 10).

Table 2. Characteristics of subjects (n=105)

Characteristic	Mean±SD	Median	Range	n (%)
Age (years)	52.6± 14.2		21-82	
Gender				
Female				61 (58)
Male				44 (42)
Duration of symptoms (years)	3.8±6.5	1	<1-40	
Number of medications	6.8±5.2	6	0-25	
Imbalance				36 (34)
Vestibular diagnoses				
Peripheral involvement				59 (56)
Central involvement				16 (15)
Unspecified dizziness				21 (20)
Mixed (central and peripheral)				2 (2)
Other				7 (7)

*Abbreviation: SD= Standard Deviation, n= number of subjects, (%) = percentage of subjects

Table 3. Specific diagnoses (n=105)

Diagnosis	N
1 - Left superior vestibular neuritis	n=2
2 - Vestibular migraine	n=7
3 - Dizziness of uncertain etiology	n=21
4- History consistent with BPPV	n=3
5 - Left vestibular neuritis due to Ramsay Hunt Syndrome	n=1
6 - Central vestibulopathy due to aneurysm	n=1
7 - Left peripheral vestibulopathy manifesting in part as BPPV	n=1
8 - Left peripheral vestibulopathy of uncertain etiology	n=9
9 - Decompensation of previous peripheral vestibulopathy	n=1
10 - Combination of vestibular migraine and endolymphatic hydrops	n=2
11 - Persistent Postural Perceptual Dizziness (PPPD)	n=3
12 - Right endolymphatic hydrops (Menieres Disease)	n=3
13 - Bilateral peripheral vestibular loss	n=3
14 - Post-concussion syndrome	n=3
15 - Right sided BPPV and left saccular reduction	n=2
16 - Right peripheral vestibulopathy	n=8
17 - Mixed central and peripheral vestibulopathy	n=1
18 - Left peripheral vestibulopathy	n=10
19 - Post-traumatic vestibular migraine	n=1
20 - Left peripheral vestibulopathy affecting otolithic function	n=1
21 - Right vestibular neuritis	n=1
22 - Peripheral vestibulopathy of uncertain etiology and lateralization	n=1
23- BPPV variant	n=4
24 - Right BPPV	n=4
25 - Dizziness due to medication effect	n=1
26 - Multifactoral imbalance	n=1
27 - Right inferior vestibular neuritis	n=1
28 - Ongoing vestibular-ocular reflex asymmetry	n=1
29 - Motion sickness susceptibility	n=1
30 - Left BPPV	n=1
31 - Central vestibulopathy	n=1
32 - Left inferior vestibular neuritis	n=1
33 - Cervicogenic dizziness	n=1
34 - Mal de debarquement	n=1
35 - Bilateral superior vestibular nerve dysfunction	n=1
36 - Cerebellar degeneration and mild peripheral vestibulopathy	n=1

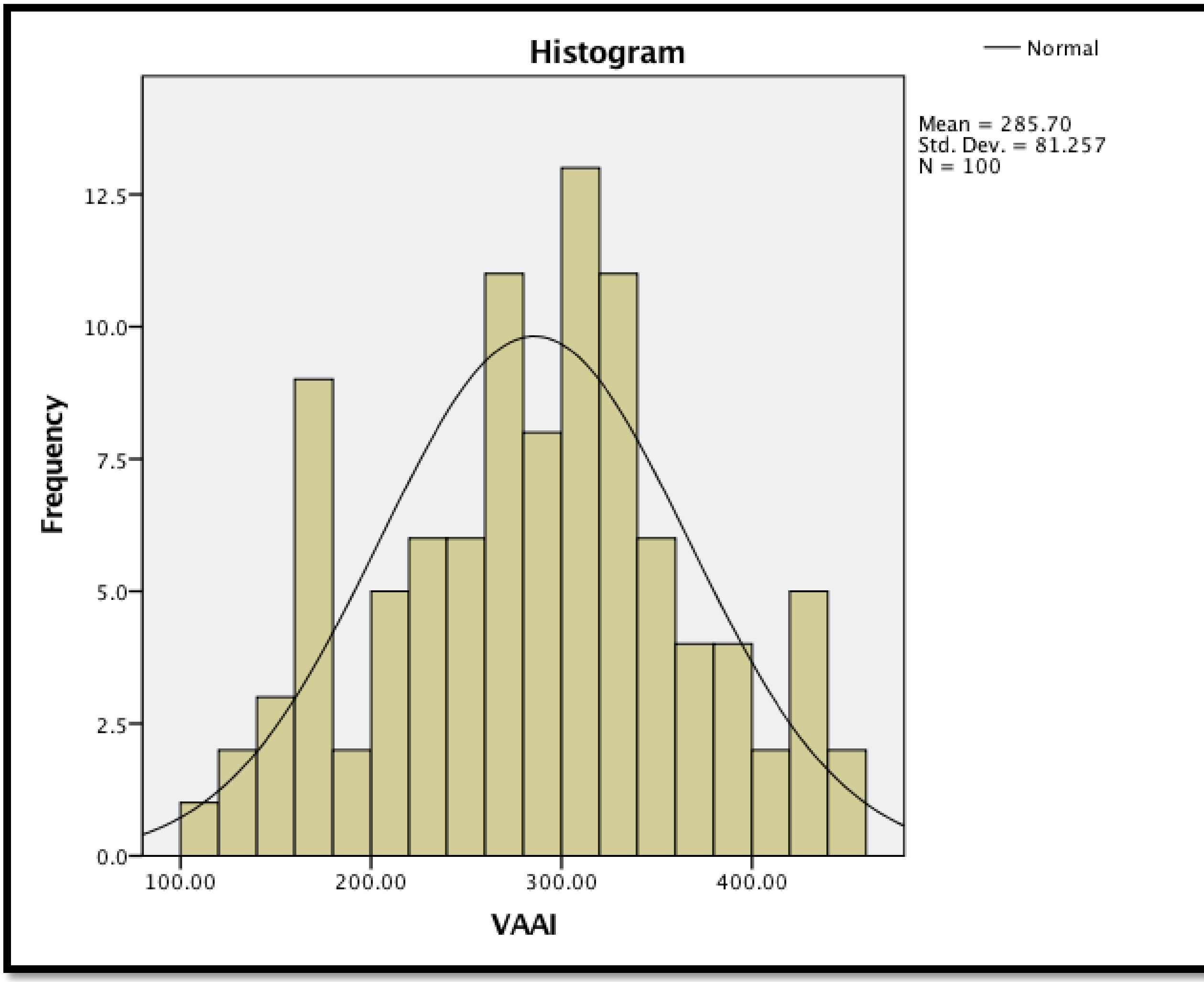

Figure 4. Vestibular Activities Avoidance (VAAI) scores distribution

The histogram shows the frequencies of various scores on VAAI

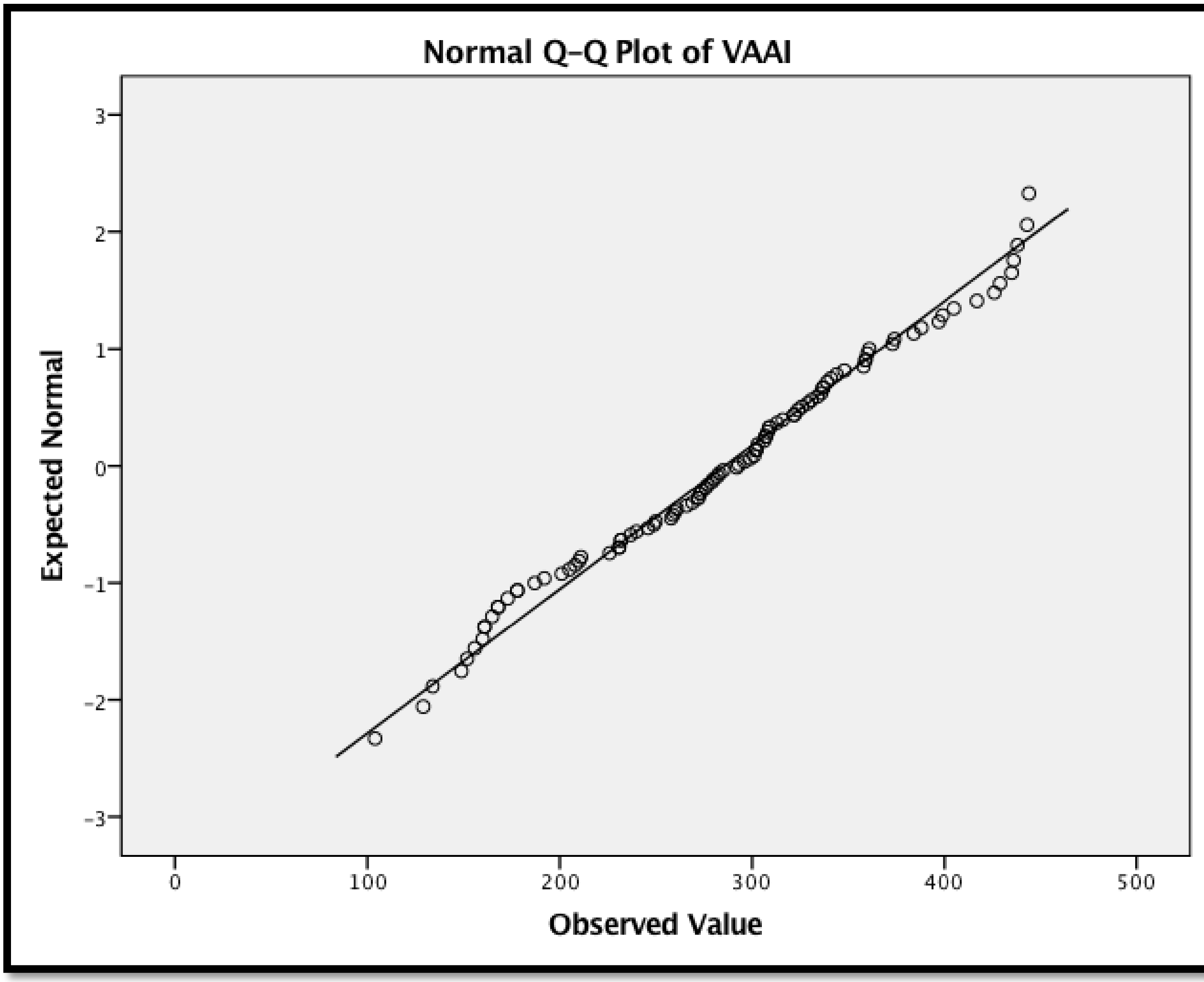

Figure 5. Normal Q-Q plot of the Vestibular Activities Avoidance Instrument (VAAI)

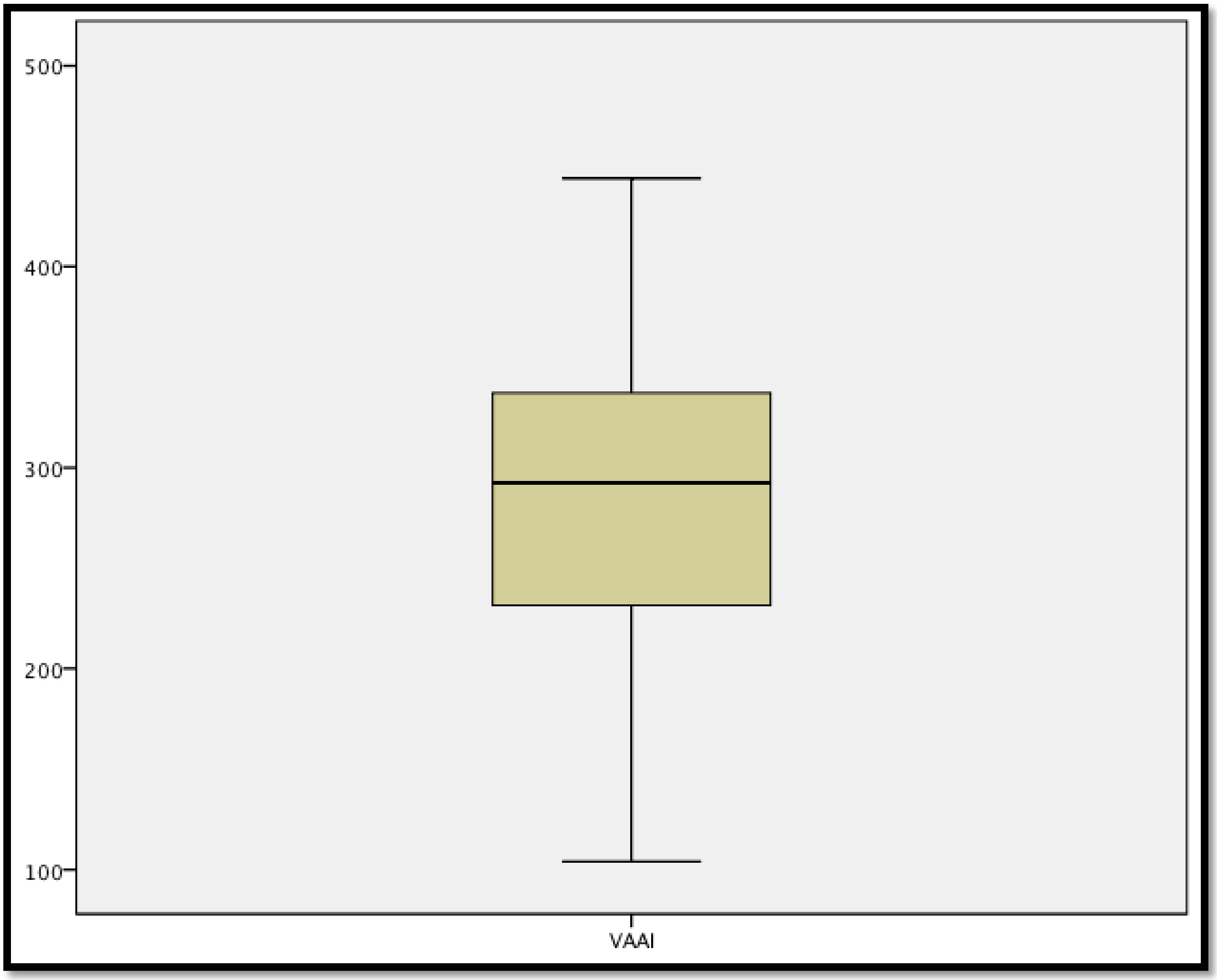

Figure 6. Boxplot of the Vestibular Activities Avoidance (VAAI)

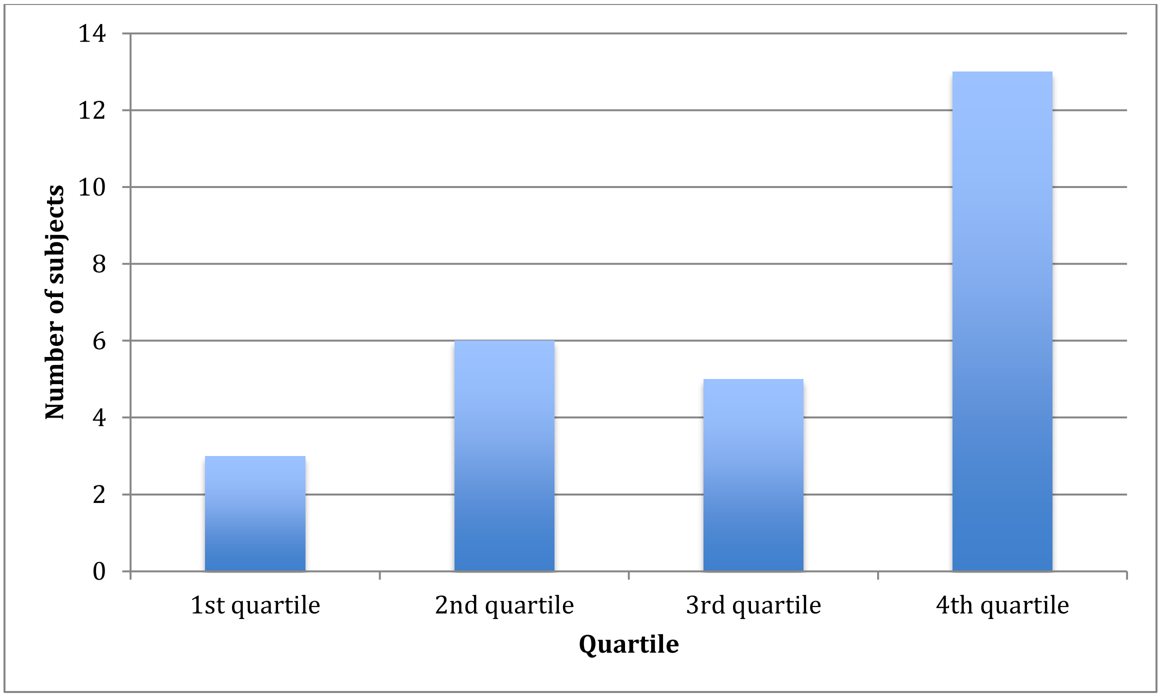

Figure 7. Number of subjects with anxiety across the VAAI four quartiles (n=27)

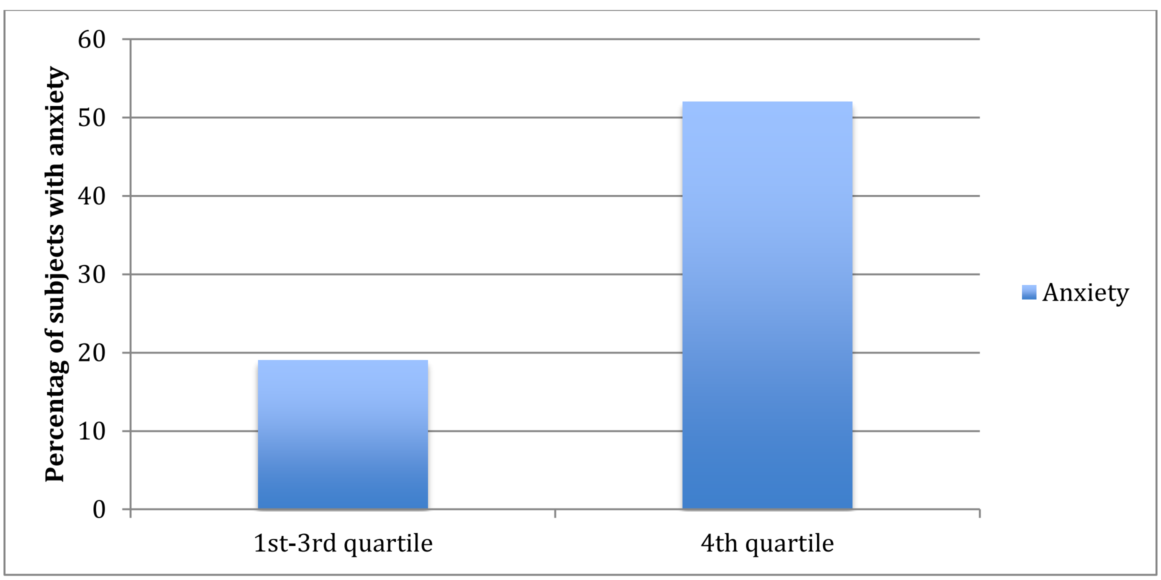

Figure 8. Proportion of subjects with anxiety 1st-3rd quartiles vs. 4th quartile (n=27)

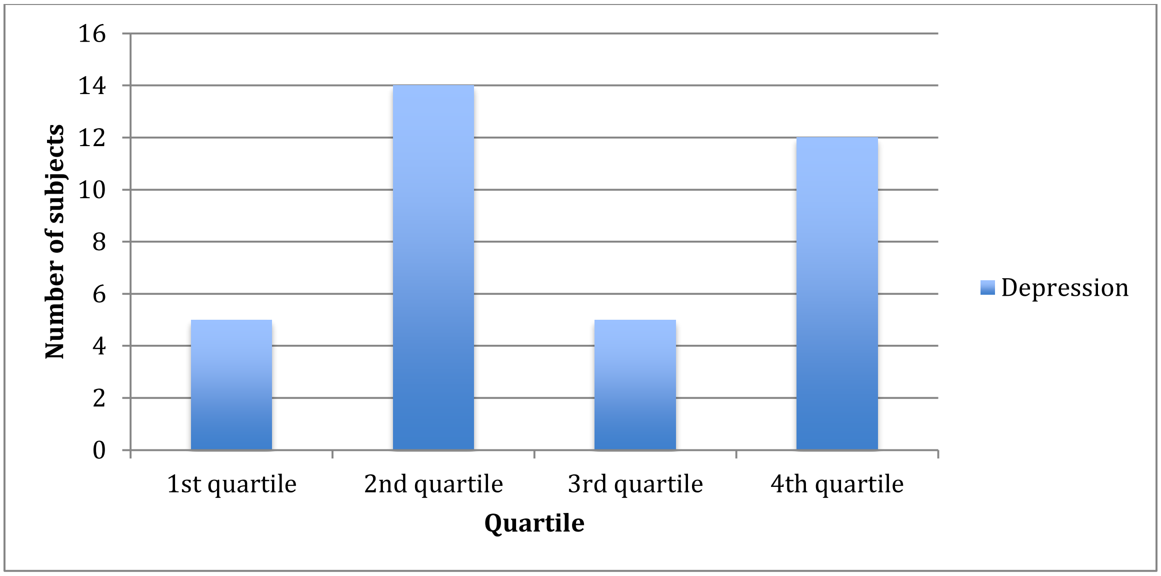

Figure 9. Number of subjects with depression across the VAAI four quartiles (n=36)

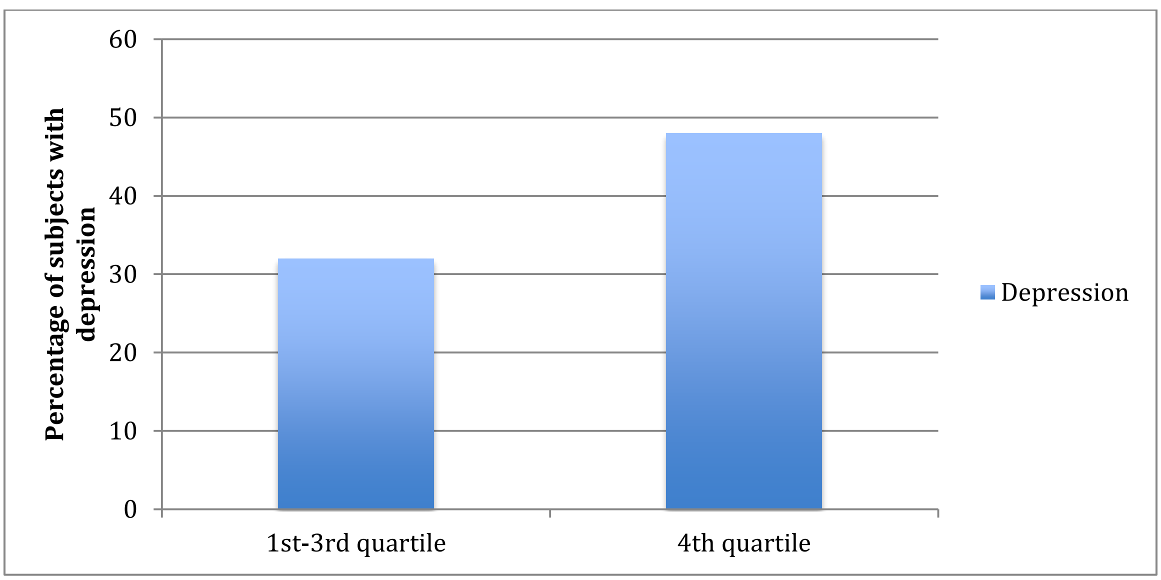

Figure 10. Proportion of subjects with depression 1^{st}-3^{rd} quartiles vs. 4^{th} quartile

4.2.2 Reliability

The VAAI score ranges from 0 to 539 with a higher score indicating high levels of activities avoidance. The mean total score of the VAAI was 286 (SD 80) ranging from 104 to 443. The test-retest reliability of the total score of the VAAI was excellent (ICC=.97; 95% confidence interval, 0.95–0.98). The Cronbach's alpha=.98. The weighted kappa for the VAAI agreement per-item between the first and second administration was poor to excellent (0.1-0.8) (Table 4). The SEM of the VAAI was 13.2 and the minimal detectable change (MDC) for the VAAI total score was 37 points.

Table 4. Quadratic weighted kappa (95% confidence interval, CI) for test-retest item agreement of the VAAI

Items	**Weighted kappa (CI)** [α]
1- My dizziness/unsteadiness bothers me.	.42 (.18-.67)
2- My dizziness/imbalance is caused by physical movement.	.60 (.42-.77)
3- When I walk down a sideway, my dizziness/unsteadiness is worse.	.74 (.63-.85)
4- I worry about my health much of the time.	.53 (.40-.67)
5- If I notice a body sensation that I cannot explain, I often find it difficult to think of other things.	.57 (.44-.70)
6- I often feel nervous, anxious or on edge.	.68 (.56-.80)
7- Physical activity makes my dizziness/ unsteadiness worse.	.73 (.62-.84)
8- I am frustrated because of my dizziness/unsteadiness.	.60 (.39-.80)
9- I am feeling down, depressed, or hopeless.	.67 (.51-.82)
10- I am afraid that I might make myself dizzy or unsteady if I exercise.	.77 (.67-.87)
11- It is difficult for me to concentrate because of my dizziness/unsteadiness.	.76 (.64-.87)

Table 4 (continued)

12- Looking up increases my dizziness/unsteadiness.	.83 (.76-.90)
13- My body is telling me I have something dangerously wrong.	.75 (.65-.85)
14- I restrict my travel for business or recreation because of my dizziness/unsteadiness.	.80 (.70-.90)
15- I should not do physical activities, which might make my dizziness/unsteadiness worse.	.67 (.52-.81)
16- It is difficult for me to walk around the house in the dark because of my dizziness/unsteadiness.	.78 (.66-.90)
17- I have had little interest or pleasure in doing things.	.73 (.58-.88)
18- I cannot do physical activities, which might make my dizziness/unsteadiness worse.	.59 (.44-.75)
19- If I were to exercise, my dizziness/unsteadiness would probably get better.	.45 (.28-.62)
20- I am not able to stop or control worrying.	.67 (.54-.79)
21- Walking down the aisle of a supermarket increases my dizziness/unsteadiness.	.87 (.80-.94)
22- I am afraid to stay home alone because of my dizziness/unsteadiness.	.84 (.74-.93)
23- I believe that I have a serious illness much of the time.	.75 (.60-.90)
24- I have difficulty getting into or out of bed because of my dizziness/unsteadiness.	.79 (.66-.92)
25- My work makes my dizziness/unsteadiness worse.	.69 (.55-.84)
26- I have been feeling tired or having little energy.	.84 (.76-.92)

Table 4 (continued)

27- I feel handicapped because of my dizziness/unsteadiness.	.79 (.70-.88)
28- I have had trouble falling or staying asleep, or sleeping too much.	.89 (.85-.94)
29- I am aware of bodily sensations much of the time.	.69 (.51-.86)
30- I have a claim for compensation for my dizziness/unsteadiness.	.81 (.69-.93)
31- My participation in social activities, such as going out to dinner, going to the movies, dancing,or going to parties is significantly restricted because of my dizziness/unsteadiness.	.80 (.71-.89)
32- Just because something makes my dizziness/unsteadiness worse does not mean it is dangerous.	.13 (-.01-.28)
33- My dizziness/unsteadiness places stress on my relationships with members of my family or friends.	.87 (.80-.93)
34- I am afraid that I might make myself dizzy accidentally.	.81 (.73-.89)
35- My family members and friends would say that I worry too much about my health.	.71 (.53-.90)
36- It is hard for me to read because of my dizziness/unsteadiness.	.21 (-.05-.4)
37- Being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my dizziness/unsteadiness from worsening.	.79 (.70-.88)
38- My work causes too much dizziness/unsteadiness for me.	.74 (.62-.87)
39- I have been worrying too much about different things.	.72 (.60-.84)

Table 4 (continued)

40- Performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away) increase my dizziness/unsteadiness.	.74 (.62-.86)
41- My dizziness/unsteadiness interferes with my job or household responsibilities.	.80 (.70-.89)
42- I am afraid to leave my home without having someone go with me because of my dizziness/unsteadiness.	.78 (.65-.91)
43- Bending over increases my dizziness/unsteadiness.	.87 (.80-.93)
44- I get the emotional help and support I need from my family.	.79 (.69-.88)
45- I have trouble relaxing.	.82 (.75-.90)
46- I should not do my regular work with my present dizziness/unsteadiness.	.78 (.68-.88)
47- I have been embarrassed in front of others because of my dizziness/unsteadiness.	.86 (.79-.93)
48- I often have headaches.	.88 (.82-.94)
49- I am afraid that I have a serious illness much of the time.	.69 (.54-.83)
50- I cannot do my normal work with my present dizziness/unsteadiness.	.84 (.76-.93)
51- Quick movements of my head increase my dizziness/unsteadiness.	.76 (.61-.92)
52- I think of myself being ill much of the time.	.83 (.71-.95)
53- Even though something is causing me dizziness/unsteadiness, I don’t think it’s actually dangerous.	.38 (.17-.60)
54- I cannot do my normal work until my dizziness/unsteadiness is treated.	.77 (.68-.86)

Table 4 (continued)

55- It is difficult for me to go for a walk by myself because of my dizziness/unsteadiness.	.78 (.67-.90)
56- I avoid heights because of my dizziness/unsteadiness.	.88 (.81-.95)
57- I often feel like I'm going to faint.	.84 (.76-.92)
58- I can't do all the things normal people do because of my dizziness/unsteadiness.	.77 (.67-.87)
59- Turning over in bed increases my dizziness/unsteadiness.	.87 (.80-.93)
60- I have been feeling my heart pound or race.	.81 (.69-.93)
61- I do not think that I will be back to my normal work within 3 months.	.73 (.59-.87)
62- It's really not safe for a person with a condition like mine to be physically active.	.68 (.51-.84)
63- It is difficult for me to do strenuous homework or yard work because of my dizziness/unsteadiness.	.84 (.76-.92)
64- I have had shortness of breath.	.87 (.78-.96)
65- Dizziness/unsteadiness lets me know when to stop exercising so that I don't injure myself.	.67 (.53-.81)
66- I am afraid people may think I'm intoxicated because of my dizziness/unsteadiness.	.87 (.80-.94)
67- Although physical activities may increase my symptoms, I would be better off if I were physically active.	.69 (.55-.82)
68- I have been feeling afraid as if something awful might happen.	.84 (.76-.91)
69- I do not think that I will ever be able to go back to that work.	.80 (.68-.93)

Table 4 (continued)

70- My dizziness/unsteadiness was caused by my work.	.61 (.41-.82)
71- If I were to try to overcome my dizziness/imbalance, my dizziness/unsteadiness would increase.	.58 (.42-.73)
72- I notice dizziness more than most people my age.	.72 (.60-.84)
73- My illness has put my body at risk for the rest of my life.	.68 (.51-.85)
74- I try to resist thoughts of illness, but often cannot do it.	.69 (.56-.83)
75- No one have to exercise when he/she is dizzy.	.69 (.56-.83)
76- I have been feeling bad about myself or that I am a failure or have let my family or myself down.	.78 (.68-.89)
77- I often have difficulty taking my mind off thoughts about my health.	.78 (.67-.89)

4.2.3 Convergent Validity

All subjects completed the SF-12 and disability questionnaire at the same time as the first administration of the VAAI (Table 5). A significant moderate to strong correlation was found between the VAAI and missing days at work, missing days with family, and missing days in social/community events (*rho*=0. 4, p<0. 05), (*rho*=0. 6, p<0. 05), and (*rho*=0. 6, p<0. 05) indicating that the VAAI has a convergent validity with the disability questionnaire. A strong significant correlation was found between the VAAI total score and SF-12 Physical and Mental Health Composite Scores (PCS and MCS) (*rho*= -0.6, p<0. 05), (*rho*= -0.6, p<0. 05). So, those with higher scores on the VAAI (worse) had lower levels of health as measured by the SF-12 sub-scores (Table 4). We examined the relationship between the VAAI-34 items (selected by the Delphi panel members) and the SF-12 sub-scores and found that the VAAI-77 items had a stronger and significant relationship with Physical and Mental Health Composite Scores (Table 6), whereas there was no significant relationship between the SF-12 and the VAAI-34.

Table 5: Patient Reported Outcome Measure Scores (n=100)

Instrument	Mean±SD	Minimum	Maximum	Range
VAAI	286±81	104	444	340
PCS	39±11	18	60	42
MCS	46±10	24	64	40
Missed days at work	2.4±4.3	0	14	14
Missed days with family	2.4±4	0	14	14
Missed days at social/community events	2.6±4.3	0	14	14

*Abbreviation: SD= Standard Deviation, n= number of subjects, VAAI= Vestibular Activities Avoidance Instrument, PCS = Physical Composite Score, MCS=Mental Composite Score

Table 6. The Spearman Rank Correlation Coefficients Between the VAAI, SF-12 composite scores, and disability questionnaire

		PCS	**MCS**	**Missing days at work**	**Missing days with family**	**Missing days in social/community events**
VAAI -77	Spearman's *rho*	-.63**	-.58**	.45**	.6**	.6**
VAAI -34	Spearman's *rho*	-.25*	-.19	.41**	.59**	.55*
	N	100	100	87	87	87

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Abbreviation: VAAI= Vestibular Activities Avoidance, PCS= Physical Composite Score, MCS= Mental Composite Score

4.2.4 Discriminant validity

Using Mann-Whitney U, there was no significant difference in VAAI total score between men and women, between subjects' with/without central involvement, and between subjects with/without self-reported imbalance (Table 7). There was no statistical significant difference in VAAI based on gender (*p*=. 7), self-reported imbalance (*p*=. 6), and diagnosis (*p*=. 13) (Figure 11, 12, 13).

Using the Spearman rank order correlation coefficient (*rho*), there was a significant moderate inverse correlation between subject age and the VAAI total score (*rho*=-0. 34, *p*<. 05). This finding suggests that younger subjects tend to have a higher perception of disability. There was no significant correlation between the VAAI total score and duration of symptoms (*rho*=0. 009, *p*=0. 93) or number of medications (*rho*=0. 002, *p=0. 98*) (Table 8). This finding was not influenced by outliers, we used both 2 SD method (any value that is more than 2 standard deviations is an outlier) also we used Box Plot diagram and both methods yielded to same results i.e. no significant relationship between VAAI and duration of symptoms or number of medications used by subjects.

In order to investigate whether our non-significant results were due to a lack of statistical power, we conducted a post hoc power analysis using the *GPower* program (Erdfelder, Faul, & Buchner, 1996) with power set at 0.80 and alpha .05, two-tailed. Between-groups comparison effect sizes observed in the present study between those with central vs. peripheral involvement was (d = .48), those with imbalance vs. no imbalance problems (d = .12), and between males vs. females (d = .13). Powers were .07, .09, and .1 respectively.

Table 7. Mean and standard deviation of VAAI scores between gender, diagnoses, and subjects with and without reported balance problems

Instrument	Gender		Central involvement		Balance problems	
	Female	Male	Yes	No	Yes	No
VAAI	291±88	279 ± 71	252±81	292±80	282±82	293±81

VAAI: Vestibular Activities Avoidance Instrument

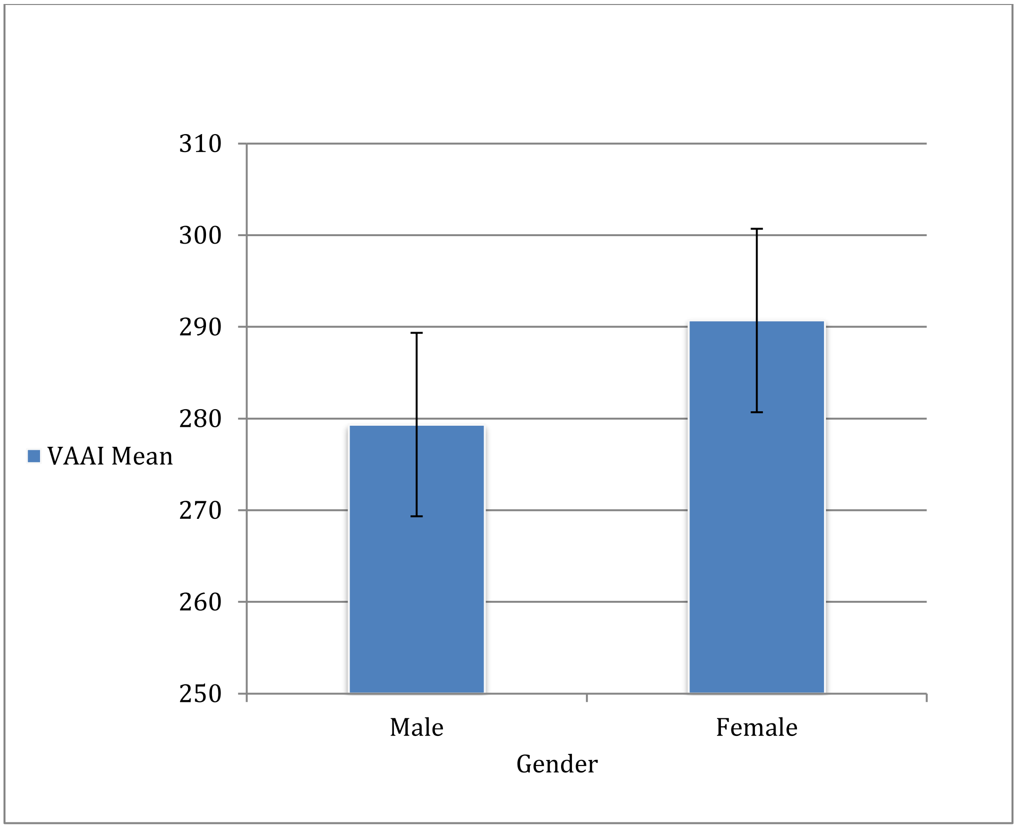

Figure 11. The VAAI total scores by gender

Error bars: Standard Error of Measurement (SEM)

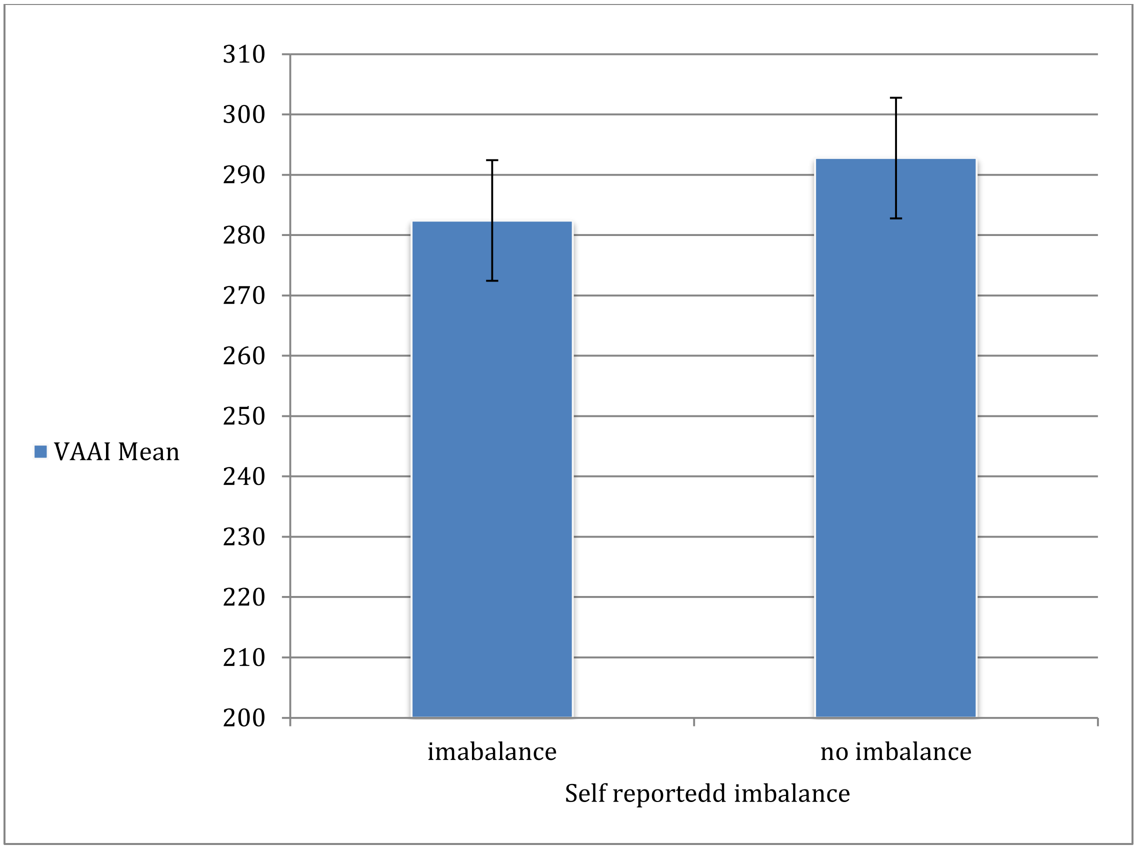

Figure 12. The VAAI total scores by self-reported imbalance

Error bars: Standard Error of Measurement (SEM)

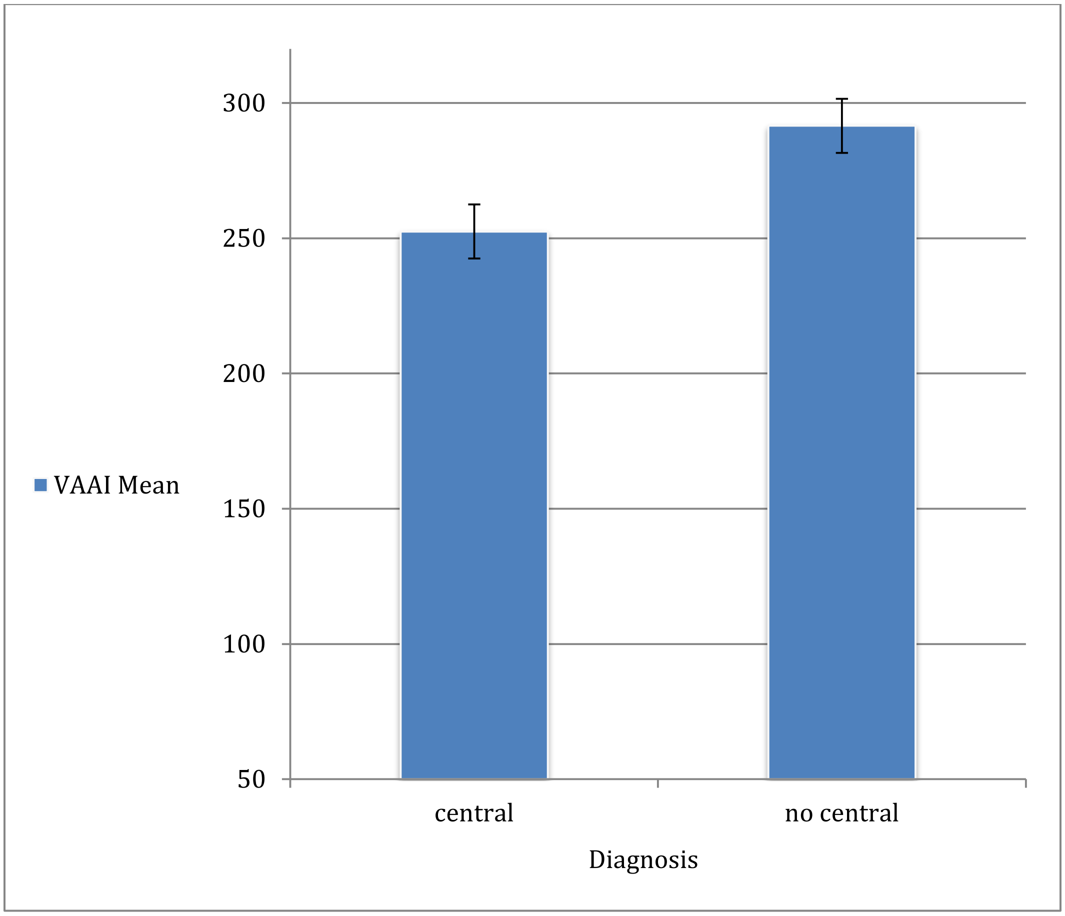

Figure 13. The VAAI total scores by diagnoses

Error bars: Standard Error of Measurement (SEM)

Table 8. Correlations of the VAAI total score with age of subjects, duration of symptoms, and number of medications (Spearman's correlations coefficients)

		Age	Duration of symptoms	Number of medications
VAAI	Spearman's rho	-0.34*	.009	.002
	p-value (2-tailed)	< 0.001	.932	.983
	N	100	100	100

Correlation is significant at *p*<. *05.*

VAAI: The Vestibular Activities Avoidance Instrument, Sig: Significant, N: number of subjects

5.0 DISCUSSION

The purpose of this study was to develop a new self-report avoidance outcome measure named the VAAI that identified individuals with vestibular and balance disorders who may avoid certain activities and circumstances or develop a fear of exercise. In addition, the goal was to establish the reliability and validity of the VAAI as a self-report measure of fear of activities in a sample of people with dizziness and imbalance.

In this study, avoidance, fear avoidance, fear of activities, depression, anxiety, somatization, catastrophization, and handicapping effects of dizziness items were utilized in an attempt to capture how people felt who were experiencing vestibular disorders. It is well known that vestibular disorders result in dizziness, vertigo, and imbalance that negatively impact the persons' ability to complete activities of daily living and reduce the overall quality of life, which contribute to disability (H. S. Cohen & Kimball, 2000; Mira, 2008; White et al., 2005). Vertigo was found to be associated with seeking consultation in medical practice (Agrawal et al., 2009; Jonsson et al., 2004; Kerber et al., 2006), sick leaves, interruption of daily activities, and people avoid leaving their home (Neuhauser HK, 2008). Psychological disturbances including panic disorders, anxiety, and depression have been reported by 50% of people with vestibular disorders (Yardley, Owen, Nazareth, & Luxon, 2001). Moreover, psychological deficits can delay recovery from vestibular disorders if not addressed during rehabilitation (Mira, 2008; Soderman et al., 2002). In order to address the psychological distress, the clinician must be able to quickly identify their psychological concerns in order to optimize their care.

Investigators in the back pain literature were one of the first groups to identify fear-avoidance as an important treatment consideration that can affect outcome (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Waddell et al., 1993). In an attempt to explain the reasons behind the development of chronic low back pain and treatment resistance, the fear-avoidance model was introduced (Lethem et al., 1983; Slade et al., 1983). Fear of pain was the main concept of the Lethem model. The model presented the two possible responses to this fear: 1) 'confrontation' which leads to decreases in fear over time and 2) 'avoidance' that leads to maintaining or worsening of pain and can result in causing a phobic state. The main components of the fear-avoidance model are catastrophizing, fear avoidance beliefs, anxiety, depression, and disability. In our study, we attempted to provide our Delphi experts with choices from the 5 item categories of the fear avoidance model listed above. As pain and dizziness can both be chronic, persistent symptoms that can affect functional mobility and participation, we felt that response to the items on the FABQ might assist in prognostication of our study subjects living with vestibular disorders.

Research on low back pain (LBP) has shown that physical, psychological, and social factors explain why some individuals would get better while others develop chronic conditions, despite treatment. Anxiety, depression, catastrohpization, and fear-avoidance beliefs have been found to be associated with the development of chronicity (Main & Waddell, 1991; Sullivan et al., 2001). Anxiety in people with chronic illness is likely to be related to excessive catastrophic concerns (Weinman J., 1996). People with vestibular disorders may interpret dizziness spells catastrophically, which leads to fear development (Yardley, 1994). Patients with LBP feel that movement is harmful for them and should be avoided (Waddell et al., 1993). Hence, dizziness and pain share similar characteristics in that they can both have rather sudden onset, may not always be predictable, and they both can cause activity avoidance, which leads to increased disability (Neuhauser HK, 2008; Wertli MM, 2014).

Studies investigating chronic low back pain have shown that using self-report outcome measures in recording fear-avoidance beliefs can predict outcomes in the rehabilitation setting (George SZ, 2015; Wertli MM, 2014). Measuring fear-avoidance behaviors when treating patients with LBP is now part of national clinical practice guidelines (Delitto A, 2012). Using screening measures to identify subgroups who are unlikely to respond to treatment based on the presence of psychological and psychosocial factors has been successful (Beneciuk JM, 2013). The ability to measure such behavior allowed for the development of cost-effective, targeted treatment approaches in physical therapy for persons with low back pain (Linton SJ, 2005; Sullivan MJ, 2003; Herman PM, 2017; Hill et al., 2008).

Fear avoidance beliefs and catastrophizing are evident in individuals other than persons with LBP. Fear avoidance beliefs have been investigated in persons with neck pain (Hart et al., 2009), sport injuries e.g. ankle syndesmosis (Sman et al., 2014), and surgical repair of proximal hamstring avulsions (Skaara et al., 2013). Fear avoidance beliefs are present in other populations and not specific to those with LBP.

The VAAI is a specialized instrument that was developed based a combination of several factors: 1) the components of the fear-avoidance model and several findings in the literature concerning the role of fear avoidance beliefs in the development of chronicity in persons with dizziness, 2) the resemblance between pain and dizziness as potentially chronic health conditions, and 3) the absence of an instrument that specifically measures fear-avoidance beliefs, or identify individuals who avoid activities, or the extent of avoidance in persons living with balance and vestibular disorders. All three factors together inspired the development of this research project and informed the need for a specialized instrument designed to detect fear, work avoidance, activities avoidance, catastrophization, somatization, plus anxiety and depression.

The development of the VAAI was accomplished by determination of experts' agreement on the items to include by using the Delphi procedure. Content validity of the VAAI was ensured by obtaining a list of agreed upon "activities avoidance" items amongst our panel of experts (Hasson et al., 2000; G. A. Morgan, Gliner, & Harmon, 2001). Content validity of the VAAI helps to ensure that a tool represents all the aspects of the construct being measured and that it is free from irrelevant factors (G. A. Morgan et al., 2001; Portney L, 2008). The 111 items that were sent to the expert panel through the Delphi process were retreived from existing measures that we thought encompassed all the important components (emotional, physical, behavioral, depression, anxiety, fear avoidance and work avoidance) that have been found to be associated with the development of fear avoidance beliefs and eventually the development of chronicity (Jacobson & Newman, 1990; Spitzer et al., 1999; Kroenke et al., 2002; Spitzer et al., 2006; Kori SH, 1990; Fritz & George, 2002; Waddell et al., 1993; Salkovskis et al., 2002; Zimet et al., 1988). Out of the 5 items that were added by one of the research group (S.W.), only one item "movement of my head makes me feel sick" was included as an item of the 111 items that were sent to the experts after combining related items and removing redundant ones.

There is no universal agreement on sample size of panelists participating in Delphi studies, nor a definition to what is considered a small or large sample (Williams & Webb, 1994).

Twenty panelists participated in the development of the VAAI. A panel of 17 national and international experts participated in the development of the VAP (Alghwiri et al., 2012) and 16 national and international experts were utilized in the developments of a diagnostic protocol for dizziness (Maarsingh et al., 2009).

The number of rounds used in the Delphi procedure is variable, however, two to three rounds are usually sufficient for most research studies (Stevens et al., 2006). The VAAI Delphi process was accomplished in three rounds. Also, as the number of rounds and effort increases, one often sees a fall in the response rate. A response rate of 70% must be preserved in order to maintain the precision of the results of the Delphi procedure (Hasson et al., 2000). In our study, seventeen out of the twenty participants completed the second round survey (75% response rate). Eighteen participants completed the third round of the survey (90% response rate).

The use of the Delphi procedure for the development of the VAAI adds strength to our study since using the Delphi procedure has many advantages over using other consensus methods. The Delphi is a quick and inexpensive procedure that allowed us to obtain experts' opinions and use of the expert's abilities and knowledge anonymously. Anonymity prevents dominance of panelist members and eliminates the unnecessary impact of personality traits, ranking, power, seniority and persuasive speaking (Westbrook, 1997). Many researchers have used the Delphi procedure in their studies in different fields. The Vestibular Activities and Participation (VAP) measure was developed using the Delphi procedure (Alghwiri et al., 2012). It was also used in the development of a diagnostic protocol for older people with dizziness (Maarsingh et al., 2009). The PaArticular Scales is another outcome measure that was developed using the Delphi procedure that helps to describe the effect of joint contractures on activities and participation in older people (Muller et al., 2016). The Delphi procedure was also used to reach experts' consensus on what clinical tests are helpful in distinguishing between cervicogenic and other causes of dizziness after sports-related concussion (Reneker, Clay Moughiman, & Cook, 2015). The Delphi is a powerful method to elicit reliable consensus from a group of experts related to a topic.

Another strength of this study was valuing patients' input via integrating their opinion during construction of the VAAI through asking them to complete the instrument and then answering their questions about the clarity of the content. After considering patients' opinion, three items were reworded based on their input. In item [73] "My injury has put my body at risk for the rest of my life", the word "injury" was changed to "illness", in item [75] "No one should have to exercise when he/she is dizzy", "should have" was changed to "have", and in item [71] "If I were to try to overcome it, my dizziness/unsteadiness would increase", the word "it" was changed to my dizziness/imbalance in order to improve clarity of the statements.

Our experts' panel was diverse and consisted of six medical disciplines. The experts had different professional backgrounds representing physical therapy, otolaryngology, psychiatry, neurology, psychology, occupational therapy, and physiatry. They also have different geographical backgrounds as they are from different countries including the United States, South America, the United Kingdom, Australia, Canada, Japan, Turkey, South Korea, Sweden, and Germany. The heterogeneity of experts can provide information from different perspectives and minimize information bias by any specific group in the subject under exploration. The experts' had an average of 22 publications with a minimum of 2 publications and a maximum of 82 publications, which makes our panel representive of a group of knowledgeable experts.

The Delphi procedure resulted in the inclusion of 34 items. However, the research team decided to include 43 more items that did not reach the 70% agreement because of their possible importance. The research team examined the results of the Delphi in a consensus meeting and felt that the Delphi experts did not include some valuable items that could be very important and would contribute to our instrument. The panel members may not have understood the aim of our project. Also, we think that our experts focused more on items that they were familiar with rather than considering the construct of fear avoidance. . All DHI items were selected as important to include to the VAAI by our experts maybe because the majority of our experts are physical therapists and they are very familiar with the DHI especially that it is one of the most powerful tools that is used with people with vestibular disorders. Also, experts did not select items that are related to social support, health anxiety and other psychological related items maybe because they are not familiar with those measures since we have only one psychiatrist in in our panel, and since psychological disorders play an important role in dizziness we thought those items should be included. We examined the relationship between the VAAI-34 items (selected by panel members) and the SF-12 Physical and Mental Health Composite Scores and found that the VAAI-77 items had a stronger relationship with levels of health as measured by the SF-12 sub-scores. The relationship with the SF 12 and the 77 item VVAI suggests that the 77 items were more comprehensive than the 34 items initially chosen by the expert panel.

It was clear after examining the 34 items that the experts had chosen few, if any items related to fear avoidance based on the literature.   Therefore, 77 items were included in the tested instrument. A shortened form of the VAAI (less than 77 items) is important in order to lower the administrative and respondent burden that may increase the use of the VAAI in the clinical setting. However, we did not have a large enough sample size to perform factor analysis that could be used to investigate the dimensionality and extract factors from the 77-items of the VAAI.

Although the Delphi is a reliable and valid method of gaining consensus and is efficient for group decision-making, the Delphi method has shortcomings. There are no guidelines for determining experts' consensus, experts' sample size or a definition of what is considered a small or big sample size. Also, it requires time and commitment from panel members and the time delays between rounds depend on the experts' availability which can lengthen the data collection process. Busy experts may dropout, however, we had a > 70% response rate in each round as recommended by Hasson et al. in order to maintain the precision of the results of the Delphi method (Hasson et al., 2000).

The test-retest reliability of the total score of the VAAI was excellent (ICC=.97), similar to other dizziness instruments including the DHI (ICC=.97) (Jacobson & Newman, 1990) and the VAP (ICC=.95) (Alghwiri et al., 2012). Four subjects (4%) had the same VAAI total scores in test and retest, 55 (55%) subjects had higher VAAI scores in the first administration compared to the second administration of the VAAI. Cronbach's alpha for the VAAI = .98. Cronbach's alpha describes the extent of how closely the items are related to each other. A very high Cronbach's alpha could indicate overlap between items, which suggests redundancy. Further item analysis in a larger sample size to identify redundant items will help reduce redundant items.

Weighted kappa for 97% of items were good to excellent (0.42-0.88) comparable to those for the VAP (.58-.94) (Alghwiri et al., 2012). Two items had poor kappa "Just because something makes my dizziness/unsteadiness worse does not mean it is dangerous" and "It is hard for me to read because of my dizziness/unsteadiness" weighted kappas (.13 and .21) respectively. The possible reasons for having a low kappa for these two items could be that for the first item, subjects might misread the item because of the negative direction that might have caused confusion. For the difficulty reading item, patients often get dizzy after testing in the vestibular lab, especially after hot and cold water caloric and rotational chair testing. Post-testing dizziness may have affected the test-retest reliability as they were all tested after vestibular testing and their change in dizziness may have affected their ability to read. There is evidence that vestibular hypofunction affects reading acuity in adults (Grossman & Leigh, 1990; Herdman, Schubert, Das, & Tusa, 2003) and difficulty reading is a common patient complaint in persons living with vestibular disorders (Braswell & Rine, 2006; H. Cohen, Ewell, & Jenkins, 1995; Grossman & Leigh, 1990)

For the assessment of convergent validity, we compared the VAAI scores with the number of missing days at work, with family, and social/community events in the last two weeks were recorded. The VAAI had a moderate relationship with missing days at work (Mean=2, SD=4.3), and a strong relationship with missing days with family (Mean=2.4, SD=4) plus missing days in social/community events (M=2.6, SD=4.3). Those with higher scores in VAAI (worse) had more missing days across the three categories. Missing days at work, household work/with family, and social/community events were used to quantify migraine related disability using the Migraine Disability Assessment (MIDAS) (Stewart, Lipton, Dowson, & Sawyer, 2001). Subjects with migraine had a mean of (.96, 3.64, and 2.6) missed days in three months at (work, housework/with family, social/community events) respectively (Stewart et al., 2000) compared to (2, 2.4, and 2.6) missed days in two week at same three domains in people with vestibular disorders in our sample. Missed days were compared between subjects in the higher quartile compared to those in the lowest quartile. Subjects in the higher quartile had higher missed days across the three categories (6, 5, and 6 days) compared to (.6,1, and .4) missed days in the lowest quartile across (work, family, social events) respectively.

The relationship between the VAAI and number of missing days at work, with family, and social events are supported by results of other studies that suggest that fear avoidance beliefs have a negative influence on function and productive work life (White et al., 2005). Gheldof and Wideman and Sullivan have reported a relationship between fear avoidance beliefs and long-term work disability (Gheldof et al., 2010; Wideman & Sullivan, 2011). The relationship between fear avoidance and missing days at work was also reported by Waddell, as fear-avoidance beliefs were strongly correlated with work loss and disability of daily living in the development of the FABQ. (Waddell et al.,1993). People with Meniere's disease have reported social, work, travel, and family difficulties as a result of unpredictable vertigo attacks (Golding & Patel, 2017). People with vestibular disorders reported a decline in their driving abilities, especially when visual information was reduced (H. S. Cohen, Wells, Kimball, & Owsley, 2003). Vestibular patients from the Cohen study reported difficulties driving in the rain, at night-time, during rush hour, pulling into or out of a parking, and altering lanes in traffic (H. S. Cohen et al., 2003). Rapid head movements and spatial navigation skills are necessary, and a decrease in visual acuity during head movements is a serious problem that may contribute to decreased activity level, avoidance of driving, diminished independence, and limited social interactions (Herdman et al., 2003). These factors may help to explain the reasons behind missing days at work and missing social and family events.

Although Cohen et al did not report missing days at work, they reported that people with Meniere's disease had work handicap (H. Cohen et al., 1995). Eighty-four percent of their subjects living with Meinere's disease had work difficulties, 70% needed to modify their job because of their disease, and two persons had to stop working because of their debilitating symptoms. Subjects reported difficulties in performing many tasks especially during attacks e.g. driving, bathing, dressing, walking, and reading. The above tasks are important activities of daily living skills and having difficulties in performing them affect people with vestibular disorders family, social, and work life.

A strong correlation was found between the VAAI total score and SF-12 Physical and Mental Health Composite Scores (PCS and MCS). Those with higher scores in VAAI (worse) had lower levels of health as measured by the SF-12 sub-scores. The strong correlation between the SF-12, which is a quality of life measure, and the VAAI is supported by the literature that emphasizes the relationship between vestibular disorders and decreased ability to complete activities of daily living and diminished quality of life (H. S. Cohen & Kimball, 2000; Mira, 2008; White et al., 2005). The SF-12 is a short form of the 36-Item Short Form Health Survey (SF-36) that has been criticized for its length (J. E. Ware, Jr. & Sherbourne, 1992). Our investigative team wanted to reduce administrative burden on our subjects so the SF-12 was chosen. The SF-12 is a reliable and valid measure(J. Ware, Jr., Kosinski, & Keller, 1996) that does not target a certain age or disease group and it has been used to measure quality life for people with vestibular dysfunction (Velez Leon, Lucero Gutierrez, Escobar Hurtado, & Ramirez-Velez, 2010), peripheral neuropathy (Van Acker et al., 2009), and older adults (Resnick & Nahm, 2001) plus many other conditions (Jakobsson, Westergren, Lindskov, & Hagell, 2012; Medina et al., 2017).

Women had slightly higher fear-avoidance beliefs than men, measured by the VAAI. This finding is similar to what is in the literature that women with vestibular disorders report higher perceived disability compared to men (Cleroux, Yardley, Marshall, Coulombe, & Lacourciere, 1992; Meli, Zimatore, Badaracco, De Angelis, & Tufarelli, 2006; Robertson & Ireland, 1995). Similar results have also been found in people with chronic LBP that women had higher fear-avoidance beliefs compared to men (Nava-Bringas et al., 2016). The reason behind the higher avoidance beliefs in women compared to men might be due to the tendency of females to ruminate and worry or that they are more anxious because they believe that worry helps them prevent future bad events and keeps them aware of warning signs (Bahrami & Yousefi, 2011).

The VAAI scores were divided into quartiles in order to better understand if there was a difference in how women scored versus men. Twenty-five subjects with age ranges of 30-82 years scored in the highest quartile on the VAAI with scores > 338 out of 539. The highest quartile scores indicate higher fear-avoidance beliefs. Fifteen (63%) of the subjects in the highest quartile group were female. Sixty-seven percent of the females in the highest quartile had anxiety (n=10) and depression (n=10) compared to 38% males (n=3) with anxiety and 22%(n=2) with depression. Women having greater anxiety and depression symptoms is consistent with previous research that indicates the women are more likely to develop an anxiety disorder (Bruce et al., 2005), and to have higher avoidance beliefs compared to men (Nava-Bringas et al., 2016). The results suggest that women in this study had slightly higher avoidance beliefs and that anxiety and depression may play a role in the development of fear avoidance beliefs.

More subjects in the higher quartile had a history of anxiety compared to the other three quartiles, which may suggest a relationship between psychological distress and the development of avoidance behavior. Fifty-two percent of subjects in the highest quartile group had anxiety (n=13), compared to 20% with anxiety (n=5) in the lowest quartile, 24% (n=6) in the second quartile, and 12% (n=3) in the third quartile. There was a significantly greater proportion of subjects with anxiety in the two highest quartiles (38%) compared with lowest quartiles (16%). Although proportion of subjects with depression in the highest quartile of the VAAI was higher (48%) than those at the lower quartiles (32%), but this was not statistically significant (p=. 1). Fear, anxiety, and depression are all psychological variables that are associated with each other and may have to interact with each other to have a greater effect (Scopaz et al., 2009). Also, anxiety might have predominant effect more than depression.

More females in this sample had anxiety, panic disorders, and depression compared to men. Twenty seven percent of the total sample had anxiety and 77% of them were female. Thirty-six percent had a history of depression and 78% of subjects with depression were female. In addition, 21% of the cohort had a history of panic disorders with 90% of those with panic disorder being female. The high number of females with anxiety, depression, and panic disorder compared to males in this sample is consistent with previous research that suggests that depression is higher in females than in males due to biological sex differences (Cyranowski, Frank, Young, & Shear, 2000; Ford & Erlinger, 2004). In addition, the prevalence of anxiety disorders, especially panic disorders, is higher in women compared to men (Bruce et al., 2005; Kessler et al., 1994). Approximately 50% of individuals with dizziness reported some psychological problems (Yardley et al., 2001) (Eagger et al., 1992) and more than 25% of those complaining of dizziness present with psychological symptoms including panic disorders and agoraphobia, with 11% comorbid incidence of anxiety and dizziness (Staab & Ruckenstein, 2003; Yardley et al., 2001).

There were no differences in fear avoidance beliefs between subjects with central vestibular disorders and those with peripheral involvement, and also between subjects who reported balance problems and those who did not. These findings are unusual compared to previous findings. People with central involvement usually have more severe symptoms than those with peripheral involvement, appear more impaired, and rarely have complete recovery (Karatas, 2008; S. L. Whitney & Rossi, 2000). Subjects with vestibular impairment who reported balance problems have more activity limitations and participation restrictions as measured by the VAP, and also more self-perceived handicap as measured by the DHI compared to those without balance problems (Alghwiri et al., 2012). In addition, there was no correlation between the VAAI total score and duration of symptoms or number of medications. Our results were similar to the findings of the FABQ that fear-avoidance beliefs do not increase with the pathological severity of the underlying disease or as a reflection of its mechanical or biomedical characteristics or its pattern (Waddell et al., 1993). It is the patients' beliefs that control their avoidance behavior (Waddell et al., 1993).

Central versus peripheral diagnoses, those with imbalance compared to those with better balance, duration of symptoms, or number of medications did not affect fear avoidance beliefs in persons with balance and vestibular disorders in this study. The post hoc power analysis revealed that the power at this given sample size to find that true (small) difference was very low which may have played a role in limiting the significance of the statistical comparisons conducted in our study.

Younger subjects tended to have higher fear-avoidance beliefs. This finding is consistent with findings from other studies that suggest that younger adults diagnosed with vestibular disorders tend to have a higher perception of disability (Alghwiri et al., 2012) and that they precieve their quality of life to be worse than older adults (Meli et al., 2006). Fear avoidance beliefs are related to self efficacy and how people preceive their disability, and younger individualas may preceive their disability to be worse compared to older patients because younger individuals are usually more involved in their community with work and family reposnsibilities. Hence, they may preceive their vestibular impairments to have more disabiling effect on their productivity than older patients.

There are several limitations of this study. First, there may have been selection bias because of the use of a convenience sample from a tertiary balance clinic that might not be representative of the entire population especially those who are unable to seek medical care for their dizziness or imbalance problems. Another limitation is the same day administration of the second VAAI to insure that subjects were stable during the test-retest interval since a patient's status can change very quickly with some vestibular conditions, and attrition is common for multiday experiment.

Same day test-retest has been used before with other instruments developed for people with vestibular disorders. In the development of the Vestibular Activities and Participation (VAP), subjects were asked to complete the second administration on the same day with a 2-5 hours gap (Alghwiri et al., 2012). In another study to establish the test-retest reliability of the Falls Efficacy Scale-International (FES-I) in people with vestibular disorders, the second test was also administered on the same day (M. T. Morgan, Friscia, Whitney, Furman, & Sparto, 2013).

In order to minimize recall bias, the order of the VAAI items was changed in the second administration (Alghwiri et al., 2012). Obtaining information from patients' medical charts that might be missing or incorrect is another potential weakness of this study. This limitation is noted as a possibility that may under or over reported, however, alpha was set at .05 so we feel very strongly that our findings should not be compromised because of this.

Ongoing research will provide a description of the psychometric properties in a composite measure of avoidance, including internal/external structure validity. Further analysis to identify item inter-correlation and possible redundancy, factor structure and an optimal scoring paradigm will facilitate a reduction in the number of items indicative of avoidance behaviors.

In summary, there is not yet a standardized way to measure fear avoidance beliefs in people with vestibular disorders. It is very important that physicians and physical therapists be aware of the central role of FABs in developing chronicity because there is a powerful relationship between FABs and poor recovery, chronicity, and work loss in persons with low back pain (Main & Waddell, 1991; Sullivan et al., 2001; Vlaeyen, Kole-Snijders, Boeren, et al., 1995). To prevent the development of chronicity, early identification of FABs and the design of more effective interventions from the acute stage may help reduce fear-avoidance beliefs before they become permanent. Studies on LBP reported that detecting elevated levels of fear-avoidance and applying alternative treatment strategies to reduce fear could improve outcomes (Linton et al., 2005).

Vestibular rehabilitation has shown its effectiveness in treating vestibular symptoms, but psychological problems may persist after treatment (Kapfhammer et al., 1997). It has been proven that cognitive behavioral therapy as an adjunct to vestibular rehabilitation helps patients to change their way in responding to their illness by teaching them to alter their behavior and confront their distorted thinking (Beidel & Horak, 2001).

Implementing cognitive behavioral therapy as an adjunct to vestibular rehabilitation is effective in reducing symptoms plus addressing anxiety and avoidance of activities that involve head movements (Andersson et al., 2006; Holmberg et al., 2006; Johansson et al., 2001). Research on chronic low back pain demonstrates that patients may have better treatment outcomes with cognitive behavioral therapy as a treatment strategy adjunct to physical therapy (Linton SJ, 2005; Sullivan MJ, 2003; Herman PM, 2017).

The assessment of fear-avoidance beliefs is essential as there is evidence that patients presenting with fear-avoidance beliefs can be treated with cognitive-behavioral techniques effectively in persons with low back pain (Delitto et al., 2012). It is also evident that people with vestibular disorders could benefit from cognitive-behavioral techniques when combined with vestibular rehabilitation (Andersson et al., 2006; Holmberg et al., 2006; Johansson et al., 2001). Identifying patients with vestibular disorders who demonstrate fear-avoidance beliefs and helping them to alter the way they respond to their illness could be the first step toward improving treatment outcomes.

6.0 CONCLUSION

The VAAI is a newly developed tool that identifies people with avoidance behaviors who were diagnosed with vestibular disorders. Seventy-seven items met expert criteria as being useful to identify potential avoidance behaviors that could be a barrier to successful rehabilitation in persons with balance/vestibular disorders. The VAAI demonstrates excellent test-retest reliability and is highly correlated with missing days at work and diminished quality of life. Future studies are planned to develop a shorter version of the VAAI and will identify factors affecting prognosis and avoidance behaviors in persons with balance and vestibular disorders, which will be the first step in determining optimal intervention and management. The impact of fear avoidance on rehabilitation outcomes may be an important issue for further research to enhance intervention strategies in this patient population.

APPENDIX A

THE VESTIBULAR ACTIVITIES AVOIDANCE INSTRUMENT

Due to your dizziness/unsteadiness, how much do you agree with each statement below?

Item	**Strongly disagree**	**Disagree**	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Agree**	**Strongly agree**
1-My dizziness/unsteadiness bothers me.							
2- My dizziness/imbalance is caused by physical movement.							
3- When I walk down a sidewalk, my dizziness/unsteadiness is worse.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
4- I worry about my health much of the time.							
5- If I notice a body sensation that I cannot explain, I often find it difficult to think of other things.							
6- I often feel nervous, anxious or on edge.							
7- Physical activity makes my dizziness/ unsteadiness worse.							
8- I am frustrated because of my dizziness/unsteadiness.							
9- I am feeling down, depressed, or hopeless.							
10- I am afraid that I might make myself dizzy or unsteady if I exercise.							
11- It is difficult for me to concentrate because of my dizziness/unsteadiness.							
12- Looking up increases my dizziness/unsteadiness.							
13- My body is telling me I have something dangerously wrong.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
14- I restrict my travel for business or recreation because of my dizziness/unsteadiness.							
15- I should not do physical activities, which might make my dizziness/unsteadiness worse.							
16- It is difficult for me to walk around the house in the dark because of my dizziness/unsteadiness.							
17- I have had little interest or pleasure in doing things.							
18- I cannot do physical activities, which might make my dizziness/unsteadiness worse.							
19- If I were to exercise, my dizziness/unsteadiness would probably get better.							
20- I am not able to stop or control worrying.							
21- Walking down the aisle of a supermarket increases my dizziness/unsteadiness.							
22- I am afraid to stay home alone because of my dizziness/unsteadiness.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
23- I believe that I have a serious illness much of the time.							
24- I have difficulty getting into or out of bed because of my dizziness/unsteadiness.							
25- My work makes my dizziness/unsteadiness worse.							
26- I have been feeling tired or having little energy.							
27- I feel handicapped because of my dizziness/unsteadiness.							
28- I have had trouble falling or staying asleep, or sleeping too much.							
29- I am aware of bodily sensations much of the time.							
30- I have a claim for compensation for my dizziness/unsteadiness.							
31- My participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties is significantly restricted because of my dizziness/unsteadiness.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
32- Just because something makes my dizziness/unsteadiness worse does not mean it is dangerous.							
33- My dizziness/unsteadiness places stress on my relationships with members of my family or friends.							
34- I am afraid that I might make myself dizzy accidentally.							
35- My family members and friends would say that I worry too much about my health.							
36- It is hard for me to read because of my dizziness/unsteadiness.							
37- Being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my dizziness/unsteadiness from worsening.							
38- My work causes too much dizziness/unsteadiness for me.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
39- I have been worrying too much about different things.							
40- Performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away) increase my dizziness/unsteadiness.							
41- My dizziness/unsteadiness interferes with my job or household responsibilities.							
42- I am afraid to leave my home without having someone go with me because of my dizziness/unsteadiness.							
43- Bending over increases my dizziness/unsteadiness.							
44- I get the emotional help and support I need from my family.							
45- I have trouble relaxing.							
46- I should not do my regular work with my present dizziness/unsteadiness.							
47- I have been embarrassed in front of others because of my dizziness/unsteadiness.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
48- I often have headaches.							
49- I am afraid that I have a serious illness much of the time.							
50- I cannot do my normal work with my present dizziness/unsteadiness.							
51- Quick movements of my head increase my dizziness/unsteadiness.							
52- I think of myself being ill much of the time.							
53- Even though something is causing me dizziness/unsteadiness, I don’t think it’s actually dangerous.							
54- I cannot do my normal work until my dizziness/unsteadiness is treated.							
55- It is difficult for me to go for a walk by myself because of my dizziness/unsteadiness.							
56- I avoid heights because of my dizziness/unsteadiness.							
57- I often feel like I’m going to faint.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
58- I can’t do all the things normal people do because of my dizziness/unsteadiness.							
59- Turning over in bed increases my dizziness/unsteadiness.							
60- I have been feeling my heart pound or race.							
61- I do not think that I will be back to my normal work within 3 months.							
62- It’s really not safe for a person with a condition like mine to be physically active.							
63- It is difficult for me to do strenuous homework or yard work because of my dizziness/unsteadiness.							
64- I have had shortness of breath.							
65- Dizziness/unsteadiness lets me know when to stop exercising so that I don’t injure myself.							

Item	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
66- I am afraid people may think I'm intoxicated because of my dizziness/unsteadiness.							
67- Although physical activities may increase my symptoms, I would be better off if I were physically active.							
68- I have been feeling afraid as if something awful might happen.							
69- I do not think that I will ever be able to go back to that work.							
70- My dizziness/unsteadiness was caused by my work.							
71- If I were to try to overcome my dizziness/imbalance, my dizziness/unsteadiness would increase.							
72- I notice dizziness more than most people my age.							
73- My illness has put my body at risk for the rest of my life.							

Item	**Strongly disagree**	**Disagree**	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Agree**	**Strongly agree**
74- I try to resist thoughts of illness, but often cannot do it.							
75- No one have to exercise when he/she is dizzy.							
76- I have been feeling bad about myself or that I am a failure or have let my family or myself down.							
77- I often have difficulty taking my mind off thoughts about my health.							

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