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Responsiveness of Self-Report Measures in Individuals with Vertigo, Dizziness and Unsteadiness

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Abstract

Objective—The responsiveness (sensitivity to change) of many self-report measures commonly used with individuals who have balance and vestibular dysfunction has not been assessed. The purpose of this study was to determine the responsiveness of four self-report measures including the Activities-specific Balance Confidence (ABC) scale, the Dizziness Handicap Inventory (DHI), the Falls Efficacy Scale-International (FES-I), and the Vestibular Activities and Participation (VAP) scale in people seeking treatment for vertigo, dizziness, and unsteadiness.

Study design—A prospective descriptive study.

Patients—Forty-five patients (mean age 56 y, range 18–79 y) with vertigo, dizziness, and unsteadiness were included.

Main outcome measures—Participants completed the measures at their initial physician examination and four to six weeks later. The follow-up visit included a Global Rating of Change Scale (GROC). The change in total scores for each self-report measure from initial visit to follow-up visit were recorded and compared against the GROC. A Spearman correlation was performed to determine the relationship between all four self-report measures and the GROC. A Receiver Operating Characteristic (ROC) curve was also used to evaluate responsiveness.

Results—Significant correlations were found between the GROC and ABC ($\rho = 0.50$), DHI ($\rho = 0.61$), and FES-I ($\rho = 0.36$), but not the VAP ($\rho = 0.27$). The ROC curve analysis showed that the area under the curve was significantly greater than 0.5 for the ABC, DHI and FES-I.

Conclusion—The DHI demonstrated the greatest responsiveness, with an optimal cutoff of a change in 3 points related to significant change.

Introduction

Dizziness is one of the most common reasons for a physician or emergency room visit in the United States.^{1,2} The impact of vertigo, dizziness, and unsteadiness on an individual's ability to function is substantial, resulting in severe limitations in everyday activities and an overall decrease in quality of life.³ There is also evidence that individuals who have a vestibular disorder have an increased incidence of falls.⁴ People with dizziness also have an associated fear of falling because of their symptoms.⁵ Vestibular disorders limit participation and restrict activities in people of all ages. Simple, everyday tasks such as climbing stairs, going to the store, and driving are commonly avoided in this population because of the fear associated with falling or an increase in symptoms.⁶ These individuals also avoid participating in their community for the same reasons. In order to better understand these debilitating issues, several instruments have been developed to attempt to assess the patient's concerns. In the clinical setting, outcome measures are a critical tool in quantifying the limitations of a patient and developing a plan of care to help patient's better reach their goals.

Responsiveness is the ability of an instrument to accurately detect meaningful change over time.^{7,8} A responsive instrument will help clinicians, patients, and other interested parties accurately assess improvement in a patient's condition when the patient reports improvement, and deterioration in a patient's condition when the patient reports worsening.⁸ The responsiveness of many self-report measures commonly used with individuals who have vertigo, dizziness, and unsteadiness has not been assessed. Despite an instrument having acceptable validity and reliability, it may not be responsive to change. It is critical to determine whether these self-report measures detect change over time in order to successfully use the questionnaires in practice. The purpose of this study was to assess the responsiveness of four self-report measures that assess different abilities related to impairment, function, and activities and participation of people with vestibular disorders.

Methods

Subjects

Individuals were enrolled who were seeking care from a neurotologist because of symptoms of vertigo, dizziness, and unsteadiness. There were a total of 45 participants who completed the study (29 females, 16 males), with a mean age of 56 y (SD 15 y, range 18–79 y). Potential participants were excluded from the study if they were unable to ambulate or could not read English. Clinical characteristics of the sample are documented in Table 1. Approximately half of the sample had evidence of peripheral vestibular dysfunction. The research study was approved by the University of ***** Institutional Review Board (PRO11030342). During the enrollment period of eight weeks, 160 consecutive subjects were initially recruited by the laboratory technicians who performed the vestibular function testing. Of these, 106 declined to participate, and 0 were excluded due to inability

to perform the study. Fifty-four subjects enrolled and completed the first study visit, and nine subjects were lost to follow-up.

Outcome Measures

Activities- Specific Balance Confidence Scale (ABC)—The Activities- Specific Balance Confidence Scale is a 16-item self-report measure designed to assess confidence in maintaining balance.⁹ It was developed as an expansion of the Falls Efficacy Scale (FES) to help describe an individual's fear of falling.^{9,10} The ABC scale ranges from 0% confidence to 100% confidence in performing daily tasks, which include walking around the house, bending over to pick up an object, and getting into a car.⁹ Through its development, the ABC Scale was determined to have good internal consistency ($\alpha = 0.96$) and good test-retest reliability with a stable total score over a two week period ($r = 0.92$, $p < .001$).⁹ Individuals who score lower on the ABC scale were more likely to report a fall in the previous year^{9,11}.

Dizziness Handicap Inventory (DHI)—The Dizziness Handicap Inventory is a 25-item self-report measure designed to quantify how an individual's self-perceived handicap affects activities of daily life.¹² It was developed with the help of patients who complained of dizziness and uses a three-item response scale, "yes/sometimes/no" scored as "4/2/0" respectively.¹² The total score ranges from zero, meaning there is no self-perceived impact of dizziness on everyday life, to one hundred, meaning there is a severe self-perceived impact of dizziness on everyday life. Through its development, the DHI was found to have good internal consistency for the total score ($\alpha = 0.89$) and satisfactory internal consistency for the subscales ($\alpha = 0.72-.85$).¹² The test-retest reliability was high ($r = 0.97$) and it was found to be responsive to change in a vestibular population.^{12,13}

Falls Efficacy Scale – International (FES-I)—The FES-I is a 16-item falls self-efficacy questionnaire based on the Falls Efficacy Scale (10 items)¹⁰ that includes 6 additional items to assess more difficult functional tasks and social-related aspects of falling.¹⁴ The self-report measures asks individuals to answer questions based on "how concerned are you about the possibility of falling," with one corresponding to "not at all," two "somewhat," three "fairly, and four "very concerned." The higher the score, the more concern an individual has for falling, thus indicating less falls-related self-efficacy. In a concurrent study, the FES-I was determined as reliable and valid in a population of individuals with a vestibular disorder, with a high test-retest reliability of 0.94 (95% confidence interval, 0.90–0.97) and significant correlations with other self-report and physical performance measures.⁵

Vestibular Activities and Participation (VAP)—The VAP is a 34-item self-report measure designed to assess the effect that vertigo, dizziness, and unsteadiness have on an individual's activities and participation.⁶ The questionnaire asks individuals to rate how much their vertigo, dizziness, and unsteadiness affects certain activities and participation in their daily life, including, but not limited to, rolling over in bed, running, and cleaning the house.⁶ The scale ranges in number from 0 to 4 and is scored by adding the total and taking the average. Zero corresponds to no difficulty, one is mild difficulty, two is moderate, three is severe, and four is unable to do. The higher the score, the greater the effect vertigo, dizziness, and unsteadiness have on an individual's activities and participation. The VAP has

high test-retest reliability (ICC = 0.95), and has been validated with the DHI and the World Health Organization Disability Assessment Schedule II.⁶

Global Rating of Change (GROC)—The 15-point Likert Global Rating of Change (GROC) Scale was designed to survey how an individual perceives how his or her condition has changed over a period of time.⁷ The scale ranges from 7 (a very great deal better) to 0 (no change) to -7 (a very great deal worse). The GROC relates change to patient perception of how much “better” or “worse” their condition is after a certain time frame or intervention.^{15,16} The GROC was rated according to the question: “Compared to before your visit with the doctor, how much has your dizziness problem changed?”

Procedure

While the participants were waiting between their vestibular function tests and their consultation with the physician, they completed the self-report measures (excluding the GROC) in random order, based on their current state of health. Four to six weeks later, participants were contacted and given the option to meet a study investigator in a physical therapy clinic to complete the measures for the second time and the GROC for the first time, or to be sent the measures via US mail. Of the 45 participants, 10 completed the measures at the outpatient physical therapy clinic and 35 returned the completed questionnaires by mail.

Statistical Analysis

Responsiveness was determined by using both distribution-based and anchor-based methods.

⁷ The distribution-based methods included the effect size (ES) and standardized response mean (SRM):

$$ES = \frac{M_1 - M_2}{SD_1} \quad SRM = \frac{M_1 - M_2}{SD_{1-2}}$$

Both the ES and SRM use the difference between the means of trial 1 (M_1) and trial 2 (M_2). ES uses the standard deviation of the baseline scores (SD_1), while the SRM uses the standard deviation of the difference scores (SD_{1-2}). Effect sizes have been qualitatively defined by Cohen to be small (0.2), medium (0.5), and large (0.8).¹⁷

Anchor-based methods using the GROC scale were also used in this study to assess an individual's perception of their condition over time. The relationship between all four self-report measures and the GROC scale was determined using a Spearman correlation, using the False Discovery Rate method to account for multiple comparisons.¹⁸ In addition, a Receiver Operating Characteristic (ROC) curve was used to evaluate the different abilities of the self-report measures to identify individuals who significantly improved based upon a GROC score of 4 or greater (i.e. moderately better).¹⁶ All subjects' data were used in the ROC analysis. The area under the curve (AUC) was computed, and the cutoff points for the minimal clinically important difference (MCID) were determined from the point on the curve closest to the upper left hand corner.

Results

Table 1 provides a summary of the clinical test results and treatment recommendations for the patient population studied. Physical therapy was the most frequent treatment recommended at 73%. The descriptive statistics for the initial, follow-up, and change scores of the VAP, FES-I, DHI, ABC, and GROC scores are illustrated in Table 2. Scores from the DHI, FES-I and VAP, but not the ABC, were significantly improved during the follow-up visit. The ES and SRM for each measure were: ABC (ES: 0.18, SRM: 0.26), DHI (ES: 0.23, SRM: 0.36), FES-I (ES: 0.24, SRM: 0.33), and VAP (ES: 0.20, SRM: 0.35). These values are considered to be small, but they are consistent among the DHI, FES-I and VAP. The ABC responsiveness measures are slightly lower.

The correlation of the change scores for each outcome measure compared with the GROC scale is detailed in Table 3. Changes in the DHI, ABC, and FES-I were significantly correlated with the GROC; however, changes in the VAP were not. Inter-correlations among the self-report measures were all significant. Using the ROC curve method to evaluate responsiveness, we found the area under the curve to be significantly different from 0.5 for the ABC, DHI, and FES-I (Table 4). The DHI demonstrated the greatest ability to discriminate between individuals who improved with GROC scores of at least 4 compared with persons with GROC scores less than or equal to 3 (Figure 1). The AUC of the DHI was significantly greater than the AUC of the VAP. The MCID of the DHI that has the best combination of sensitivity and specificity is 3 points.

Discussion

The ABC scale, DHI, and FES-I are responsive self-report measures that quantify balance confidence, self-perceived handicap, and fear of falling in individuals with a vertigo, dizziness, and unsteadiness, respectively. Although the VAP demonstrated a statistically significant improvement of scores from the initial to follow-up visit, it did not exhibit a significant correlation with the GROC or on AUC greater than 0.5. The VAP demonstrated a small ES and SRM, but responsiveness should not be determined by a distribution-based method alone.

The DHI had the highest correlation with the GROC of the measures that were studied. Since the prompt for the GROC asked “how much has your dizziness problem changed”, it is not a surprise that the DHI, which assessed how dizziness affected a person’s daily life, had the strongest relationship. Initial scores over 40 on the DHI indicate that the patients had moderate handicap from their dizziness.¹⁹ In addition, a majority of the individuals who are seen at the clinic have dizziness as their primary complaint. It was somewhat unexpected, however, that the VAP did not demonstrate more responsiveness. This finding may be explained by the relatively low initial VAP score as well as the small amount of change, suggesting that the vertigo, dizziness, and unsteadiness symptoms did not substantially interfere with the activities and participation of the group. The finding that the ABC and FES-I had significant correlations with the GROC demonstrates that improvements in balance confidence and concern about falling are positively affected by improvements in dizziness.

An 18 point change on the DHI is considered to be clinically meaningful, based on the measurement reliability.¹² Our cohort of patients had a mean improvement of 6 points, suggesting that DHI change did not meet the criteria for clinically meaningful change according to the reliability-based method. However, using a responsiveness criterion, we determined that a 3 point improvement in DHI equates with individuals achieving a 4 point change or better on the GROC. How do we interpret these seemingly discordant values? It must be noted that both studies had relatively small sample sizes (45 for the current study, 14 for the reliability study of the DHI¹²), so a larger sample investigation of the responsiveness should be undertaken.

Research to examine the responsiveness of measures in individuals with vertigo, dizziness, and unsteadiness has commenced only recently. A recent study examined the SRM and minimal clinically important difference (MCID) for the Dynamic Gait Index and Functional Gait Assessment (FGA) in a population of individuals with balance and vestibular disorders. Both the DGI and the FGA were found to be significantly responsive for those patients who show a clinically important change on the DHI.²⁰ These results suggest that both physical and self-report outcome measures have the ability to detect meaningful change in a vestibular population. Further directions for this study would be to examine the responsiveness of these measures for individuals who have received treatment interventions for vertigo, dizziness, and unsteadiness.

One of the limitations of the study was that patients were seen at a tertiary care center making the findings more difficult to generalize to a more diverse population. An additional limitation was the timeframe given between the initial visit and the follow-up. Four to six weeks was determined based on clinical experience, but may not have been long enough to detect a stronger meaningful change. The variety of interventions that may have been utilized during this time frame could also be a limitation to our study. Additionally, only 1/3 of the potential subjects agree to participate in the survey during their clinic visit.

Conclusions

The ABC scale, DHI, and FES-I are considered to be moderate to highly responsive self-report measures as indicated by the correlations with the GROC scale and the statistically significant difference from 0.5 for areas under the curve.

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Clinical Relevance

The ABC scale, DHI, and FES-I can be considered useful clinical tools because they are responsive to change. While the VAP was not statistically significant, it can be considered a useful clinical tool to assess a patient's limitation in activities and participation due to vertigo, dizziness, and unsteadiness. The FES-I, along with the ABC scale and DHI can measure an individual's fear of falling, balance confidence, and self-perceived handicap due to vertigo, dizziness, and unsteadiness, which in turn, may lead clinicians to the source of the limitation in everyday activities.

Figure 1.

Receiver Operating Characteristic curve for the improvement in the Dizziness Handicap Inventory (DHI), measured against the Global Rating of Change scores greater than 3. Labels represent cutoff values for the amount of improvement in the DHI to produce sensitivity and 1-specificity values for subjects who reported a Global Rating of Change score greater than 3. Filled squares represent cutoff values closest to the upper left hand corner.

Table 1

Clinical characteristics of study cohort.

Demographics	Age: mean 56 y (SD 15 y, range 18–79 y) Gender: 29 Females, 16 Males
Diagnostics	Symptoms duration: median 76 weeks (range 4 – 832) Unilateral vestibular hypofunction: 44% BPPV: 27% Migraine-related vestibulopathy: 13% Bilateral vestibular hypofunction: 7% Meniere's Disease: 2% Unspecified dizziness: 20%
Vestibular function test results	Abnormal Calorics: 44% Abnormal cVEMPs: 45% Abnormal rotational chair: 55% Abnormal positional: 23%
Treatment recommendations	Physical therapy: 73% Canalith repositioning maneuver: 16% Change diet: 9%

Diagnoses are not mutually exclusive

cVEMP: cervical Vestibular Evoked Myogenic Potential

Abnormal caloric test: > 24% asymmetry or total eye speed < 20 deg/sec

Abnormal VEMP test: asymmetry > 29% or absent response

Abnormal rotational chair test: reduced gain, phase lead, or directional preponderance

Abnormal positional test: slow phase velocity < 4 deg/sec (< 6 deg/sec for age >65)

Table 2

The mean, standard deviation and ranges of participant scores for the Activities-specific Balance Confidence (ABC) scale, the Dizziness Handicap Inventory (DHI), the Falls Efficacy Scale International (FES-I), the Vestibular Activity and Participation (VAP) scale, and the Global Rating of Change (GROC) scale. Positive change scores represent improvement. (p-value from Wilcoxon signed ranks test comparing final score with initial score)

Outcome Measure	Initial Mean (SD) [Range]	Final Mean (SD) [Range]	Change Mean (SD) [Range]	p-value
ABC	63 (27) [4 – 100]	67 (26) [8 – 100]	5 (18) [–34 to 60]	0.138
DHI	45 (25) [6 – 92]	39 (27) [0 – 100]	6 (16) [–32 to 56]	0.024
FES-I	32 (13) [16 – 64]	28 (11) [16 – 63]	3 (9) [–8 to 47]	0.047
VAP	1.2 (0.8) [0.1 – 2.9]	1.0 (0.8) [0.0 – 3.1]	0.2 (0.5) [–0.9 to 1.5]	0.032
GROC	-	-	3 (3) [–4 to 7]	-

Table 3

Correlation of Change Scores for the Activities-specific Balance Confidence (ABC), the Dizziness Handicap Inventory (DHI), the Falls Efficacy Scale International (FES-I) scale, and the Vestibular Activity and Participation (VAP) scale, and the Global Rating of Change scale (GROC).

Outcome Measure	ABC	DHI	FES-I	VAP
GROC	0.50 p = 0.001	0.61 p < 0.001	0.36 p = 0.015	0.27 p = 0.077
ABC		0.66 p < 0.001	0.34 p = 0.023	0.38 p = 0.011
DHI			0.53 p < 0.001	0.41 p = 0.005
FES-I				0.35 p = 0.020

Table 4

Receiver Operating Characteristic curve statistics for the Activities-specific Balance Confidence (ABC), the Dizziness Handicap Inventory (DHI), the Falls Efficacy Scale International (FES-I) scale, and the Vestibular Activity and Participation (VAP) scale, measured against Global Rating of Change scores greater than 3.

Outcome Measure	Area under the Curve	95% Confidence Interval (CI)	p-value
ABC	0.72	0.57 – 0.87	0.011
DHI	0.80	0.66 – 0.93	0.001
FES-I	0.69	0.53 – 0.84	0.032
VAP	0.60	0.44 – 0.77	0.238