Utility Measures of Health-Related Quality of Life in Patients Treated for Benign Paroxysmal Positional Vertigo

Richard A. Roberts,[1] Harvey Abrams,[2] Melanie K. Sembach,[3] Jennifer J. Lister,[4] Richard E. Gans,[5] and Theresa Hnath Chisolm[4]

Objectives: Comparing the effects of different disorders and interventions on health-related quality of life (HRQoL) is important for healthcare policy and accountability. There are two basic approaches to measure HRQoL: questionnaires derived from psychometrics and preference-based measures or utilities derived from econometrics. While disease-specific HRQoL questionnaires, such as the Dizziness Handicap Inventory (DHI), are important because they focus on the impact of a specific problem and its treatments (i.e., vestibular disorders), economic comparisons of the impacts of diseases/disorders and their treatments are typically based on utility assessment. The utility measures for audiology application (UMAA) were developed to measure utilities for various audiologic conditions using a standard computer. The purpose of this study was to determine if the UMAA provides stable, valid, and sensitive utility measures of the effects of benign paroxysmal positional vertigo (BPPV) and its treatment on HRQoL. It was hypothesized that utilities, as measured by the UMAA, would indicate improvement in HRQoL post-treatment for BPPV comparable to a disease-specific health status measure (DHI).

Design: The UMAA incorporates three techniques to measure utility: rating scale, standard gamble, and time tradeoff. A utility is a cardinal measure of strength of preference and is measured on a continuum basis from 0.0 (incapacitating dizziness) to 1.0 (no dizziness). Fifty-two adults with BPPV of the posterior semicircular canal completed the UMAA and DHI before treatment and again post-treatment. A subgroup of 15 participants completed the UMAA on two occasions before treatment to assess test-retest stability and to establish critical difference values.

Results: Results from this investigation demonstrate that utilities as measured through the UMAA are stable, valid, and comparable to the DHI. Post-treatment utilities were also significantly higher than pretreatment utilities, indicating that the utilities, as measured through the UMAA, are sensitive to improvement in HRQoL after BPPV treatment.

Conclusions: Utilities as measured through the UMAA seem sensitive to changes in HRQoL after treatment of BPPV. Since the UMAA can be used to measure patient preference (i.e., utility), it may be useful for comparison of specific audiologic conditions, such as BPPV, to nonaudiologic conditions, such as cardiovascular disease and kidney disease.

(Ear & Hearing 2009;30;369–376)

INTRODUCTION

Vertigo and Health-Related Quality of Life

Patients who experience vertigo have reported that its symptoms cause frustration, disrupt their normal activities, and profoundly and negatively impact their health-related quality of life (HRQoL) (Gamiz & Lopez-Escamez 2004; Lopez-Escamez et al. 2003). Evaluating the HRQoL consequences of disease and injury has taken on increasing importance in recent years. Indeed, the United States Food and Drug Administration is encouraging pharmaceutical companies to include HRQoL outcome measures as part of their clinical trials investigating new drugs (George 2006). The value of HRQoL assessment lies in its ability to directly compare the social, emotional, psychological, and financial impacts of medical conditions and interventions across and within diseases and injuries. This information is of considerable interest and importance to clinicians, healthcare planners, policy makers, and third-party payers for the purposes of making budget and resource allocation decisions (Abrams & Chisolm 2000).

In general, HRQoL can be assessed using health status or patient preference (i.e., utility) measures. Health status measures are based on psychometric principles and assess multiple aspects of a patient's self-perceived well-being. A score is derived from a series of questions that reflect the patient's relative HRQoL compared with other individuals or with the same patient at other points of time. Health status measures can be disease specific (e.g., the Dizziness Handicap Inventory [DHI]; Jacobson & Newman 1990) or generic (e.g., the Medical Outcomes Study [MOS] SF-36 Health Survey [SF-36]; Ware & Sherbourne 1992). Patient preference measures on the other hand are derived from econometric principles, specifically the concept of decision making under conditions of uncertainty, and are referred to as utilities. A utility is a patient-assigned value ranging along a continuum from 0.0 to 1.0 that quantifies an individual's preference for a particular health state or condition. The least favorable condition is represented with 0.0 (e.g., death), and the most favorable condition is represented with 1.0 (e.g., perfect health; Nease et al. 1995).

As with health status instruments, utility measures can also be classified as either disease specific or generic. While patient preferences can be measured with generic anchors (i.e., "perfect health" and "death"), for many disorders the lack of sensitivity of such assessment approaches has resulted in the development of methods to assess disease-specific utilities (Krahn et al. 2007; Stolk & Busschbach 2003; Wasserman et al. 2005). The advantage that utility measures have over health status instruments is that comparisons among different health-related conditions and treatment effects can be displayed with a single scoring method. Consequently, current health economic practices incorporate patient preferences into formal cost-effectiveness models. One goal of this project was to

[1]Alabama Hearing and Balance Associates, Foley, Alabama; [2]Bay Pines VA Healthcare System, Bay Pines, Florida; [3]West Texas Rehabilitation Center, Abilene, Texas; [4]Department of Communication Sciences and Disorders, University of South Florida, Tampa, Florida; and [5]The American Institute of Balance, Seminole, Florida.

0196/0202/09/3003-0369/0 • Ear & Hearing • Copyright © 2009 by Lippincott Williams & Wilkins • Printed in the U.S.A.

examine the stability, validity, and sensitivity of disease-specific utilities for various health states specifically related to benign paroxysmal positional vertigo (BPPV).

As noted earlier, a common disease-specific health status instrument used to evaluate the consequences of dizziness is the DHI. The DHI is a 25-item scale designed to evaluate the functional, emotional, and physical aspects of a person's dizziness (Jacobson & Newman 1990; Lopez-Escamez et al. 2003). Overall findings from studies investigating the validity of the DHI indicate weak to moderate correlation between DHI results and physiologic measures of postural stability (Jacobson et al. 1991; Loughran et al. 2005; Perez et al. 2003). Whitney et al. (2004) reported that patients with the greatest functional impairment on several measures also had the greatest total DHI scores. Despite the lack of strong correlation with physiologic measures, this scale is probably the most widely used by clinicians given its ease of administration, scoring, and excellent test-retest reliability (Jacobson & Newman 1990).

A disease-specific measure such as the DHI is of particular interest and value to clinicians because of its responsiveness to treatment. The specific nature of the items on the questionnaire serves to enhance the sensitivity of the instrument. The items on the DHI are so specific, however (e.g., "Do quick movements of your head increase your problem?"), that the score cannot be used to compare the HRQoL consequences of vertigo with those obtained for other disorders such as depression, heart disease, or cancer. Preference-based measures such as utilities, on the other hand, do allow such comparisons. However, unless the utility measure incorporates disease-specific language or anchors, the measure may not be responsive to the impact or intervention associated with a specific disorder (Bergner et al. 1981; Ware & Sherbourne 1992).

As previously noted, HRQoL can be assessed using health status instruments or utilities. Utilities can be measured using several techniques, including rating scale (RS), standard gamble (SG), and time tradeoff (TTO). For the RS technique, patients locate their perception of the HRQoL effect of their disorder along a scale (a "feeling thermometer") from 0 to 100, where 0 represents the least favorable condition (e.g., death or incapacitating dizziness) and 100 represents the most favorable condition (e.g., perfect health or no dizziness; Bozic et al. 2003). The patient ranks self-perception of their current health state at any point along the scale.

Another technique is SG. With this method, the patient must decide between two choices while trading his or her current health state for a better health state that also comes with a risk of failure (Beaton & Schemitsch 2003). The patient is prompted to make a choice between maintaining his or her current state of health and receiving a "magic pill" that will cure his or her disease, but with the possibility of some extremely negative consequence such as death. The SG technique is designed to determine what chance of death (or incapacitating dizziness) the patient is willing to risk to have perfect health (no dizziness).

The TTO technique is similar to SG in that the patient has a choice, but there is an important difference. The point of this technique is to determine how much time the patient with a current health state is willing to trade for a normal health state (Beaton & Schemitsch 2003). Patients are asked to "trade" years of their lives for perfect health in the fewer, remaining years. Using the TTO technique, the patient chooses between a decreased number of years of perfect health (no dizziness) and a greater number of years living with the less desirable health state (current dizziness). The years are varied until the patient can no longer choose between the two options.

Benign Paroxysmal Positional Vertigo

The most frequent vestibular cause of vertigo is BPPV (Bath et al. 2000). Brief episodes of vertigo are provoked when the head is moved into certain positions (Dix & Hallpike 1952; Parnes & McClure 1992; Schuknecht 1969). Symptoms arise when otoconia from the utricle become displaced into the affected semicircular canal. As the head is moved into a provoking position, the otoconia move within the semicircular canal, which causes movement of the endolymphatic fluid and cupula. This movement results in a sensation of vertigo coincident with a rotary nystagmus directed upward and toward the affected ear (Roberts et al. 2006). The most affected canal is typically the posterior semicircular canal because of its physical location in comparison with the utricle (Roberts & Gans 2008). Medications have proven ineffective for the treatment of BPPV. Instead, the use of repositioning treatment maneuvers is highly efficacious (Epley 1992; Herdman et al. 1993; Roberts et al. 2006; Semont et al. 1988). Most studies suggest an efficacy of 80% to 95% with one to two treatment maneuvers. A comprehensive review of BPPV may be found in Roberts and Gans (2008).

BPPV and HRQoL

The effect that BPPV has on HRQoL has been previously measured using generic HRQoL scales through profiles such as the SF-36 (Gans & Crandell 2000; Lopez-Escamez et al. 2003; Ware & Sherbourne 1992). Gans and Crandell (2000) demonstrated a significant improvement in post-therapy outcomes on HRQoL for patients with posterior semicircular canal BPPV (PC-BPPV). With only one to two repositioning maneuvers, significant improvement was observed for the subscales of General Health, Mental Health, and Vitality and the total SF-36 score.

Comparisons between generic (SF-36) and disease-specific (DHI) health status measures have also been made for patients with BPPV (Lopez-Escamez et al. 2003). Pretherapy scores were significantly poorer for their group with BPPV compared with normal subjects for all subscales except Vitality. The authors reported that all subscale scores were closer to those of the normal population after treatment with repositioning, with significant improvements in the scores for Social Function and Mental Health. A significant improvement was also observed when comparing pre- and post-therapy DHI scores. The authors validated the SF-36 for this population by showing significant correlations between SF-36 subscale results and results from DHI, particularly for post-therapy SF-36 results. Results from Gamiz and Lopez-Escamez (2004) are in agreement with those of Lopez-Escamez et al. (2003) but for an older group of participants.

Although there are few reports in the literature measuring HRQoL in patients pre- and post-treatment of BPPV, there are no published data using utilities. Recently, the utility measures for audiology application (UMAA; Roberts & Lister 2005) were created as an efficient way to measure disease-specific utilities for hearing loss, tinnitus, and dizziness. This computer application can be loaded onto a laptop computer and brought

into the examination room to be completed by the patient with assistance from the examiner if required. The application presents the choices to the patient and adaptively varies the number of years for TTO or the chance of the incapacitating health state for SG based on the prior response of the patient. Using a computer application seemed easier from a methodological standpoint to facilitate the use of utilities as opposed to a "paper and pencil" method used by others. The UMAA also provides immediate scoring and stores the patient data in a data base for off-line analysis.

Because there are no published utility data among patients with dizziness, test efficiency data concerning RS, SG, and TTO utility measurement techniques needed to be established in this population. The purpose of this study was to determine if disease-specific utilities, as measured with RS, SG, and TTO techniques and administered by a computer program (UMAA), are stable and valid, as well as capable of demonstrating improvement post-treatment for adults with BPPV. It was hypothesized that results would indicate improvement in HRQoL post-treatment for BPPV comparable with a disease-specific health status measure (DHI).

TABLE 1. Information regarding the 52 participants is shown along with the type of initial treatment for benign paroxysmal positional vertigo (BPPV) and number of treatments until the patient was clear

Age (yr)	
Range	31–81
Mean	65
Gender	
Female	35
Male	17
Involved ear	
Right	32
Left	20
Type of initial repositioning treatment	
GRM	42
CRM	8
SLM	2
No. treatments needed to clear BPPV	
One	32
Two	13
Three or more	7

Treatments were Gans repositioning maneuver (GRM), canalith repositioning maneuver (CRM), and Semont liberatory maneuver (SLM).

PATIENTS AND METHODS

Participants

Participants for this study were recruited from patients seen for vestibular and equilibrium evaluation at the American Institute of Balance in Seminole, FL. All patients underwent comprehensive evaluation performed by audiologists with specific training in vestibular assessment and management. Standard assessment for all patients included detailed discussion of history and symptoms, rotary chair, videonystagmography (VNG), vestibular-evoked myogenic potential, and postural stability testing. Headshake testing is also a standard component of our VNG protocol for all patients. For patients with a history consistent with possible uncompensated vestibular dysfunction, lateral headshake testing was also completed during VNG; dynamic visual acuity testing was completed as well. Auditory brain stem response was performed only on patients without recent imaging studies. Electrocochleography was performed only on patients with a history consistent with Meneire disease, and these patients were not eligible for inclusion based on history and symptoms. Standard audiometric results were also obtained but were not used to specifically exclude patient participation (i.e., presence of sensorineural hearing loss).

As commonly done in most settings that conduct vestibular testing, all patients were asked to refrain from medications that are known to have the potential to influence evaluation results. This would include vestibular suppressant medications, alcohol, nicotine, etc. Patients were not asked to refrain from any medications for the treatment visit or follow-up appointment.

To exert greater experimental control, patients with primary or "idiopathic" BPPV (Katsarkas 1999; Karlberg et al. 2000) were sought for inclusion in the current study. Patients were eligible for inclusion if they had a positive response on either the modified Dix-Hallpike maneuver (Roberts & Gans 2008; Roberts et al. 2005a,b) or side-lying maneuver (Cohen 2004; Roberts & Gans 2008) and had been diagnosed as having unilateral PC-BPPV as a sole finding. Patients with other abnormal test findings such as postheadshake nystagmus or abnormal vestibular-evoked myogenic potential were excluded. For example, patients with BPPV secondary to other inner ear disorders such as vestibular neuritis were excluded based on history alone or any abnormalities on evaluation. In addition, patients reporting memory problems, psychiatric illness, communication barriers, or previous treatment for BPPV of any semicircular canal were also excluded.

A total of 52 patients met the inclusion criteria and agreed to participate in the current study. Specific information about the participants is given in Table 1. All participants also indicated fluency in English, which was important as they were asked to answer questions about their quality of life. Information regarding coexisting medical diagnoses is shown in Figure 1. As would be expected based on other investigations, cardiovascular disease and diabetes are often reported in patients with BPPV (Appiani et al. 2001; Cohen et al. 2004; Roberts et al. 2005b). In the current study, arthritis, breathing problems, cancer, and depression were also prominently reported.

Instruments and tests • All participants completed the UMAA and the DHI. The UMAA was completed using a Compaq Presario 1270 laptop with a Pentium processor. Individual participant results were stored in a data base for export to a spreadsheet. The DHI was completed by paper and

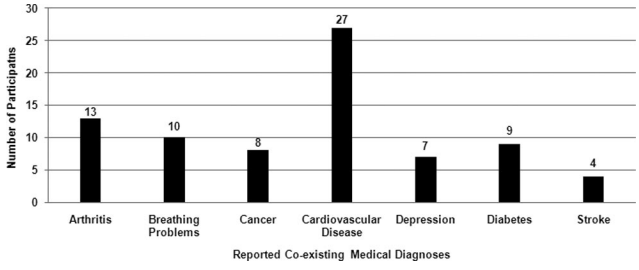

Fig. 1. The number of participants reporting specific coexisting medical diagnoses is shown.

pencil. Data were entered directly into the spreadsheet with other participant results.

The UMAA was used to present the utility tasks and to input participant results into the data base. The three techniques used were the RS, SG, and TTO as described in the Introduction section. The UMAA was used to specifically examine the overall HRQoL with regard to dizziness.

As described previously, the DHI is a 25-item questionnaire designed to measure the functional, social, and emotional impact of dizziness. The patient is given three answer choices for each question: never, sometimes, or always. The choices are assigned 0 ("never") to 4 ("always") points with lower scores representative of less dizziness handicap. Each item is totaled within the domain (functional, social, or emotional) for which it is coded; however, responses to the items are also added together to obtain an overall score. Only the overall score was considered for analysis in the current study. Comparison of DHI individual domains with UMAA results will be addressed in a forthcoming investigation. The DHI was compared with the UMAA before and after treatment as a measure of the validity of the UMAA.

Procedures

All participants completed the UMAA and DHI before treatment and again post-treatment. A subgroup of 15 participants completed the UMAA and DHI on two pretreatment occasions to provide a measure of test-retest stability and to establish critical difference values. The subgroup completed these measures on the date of initial evaluation, on the date of treatment (but before actual treatment), and a third time on the date of the post-treatment follow-up appointment.

Initial visit • The diagnosis of unilateral PC-BPPV was made on the basis of a history of transient positional vertigo and a positive modified Dix-Hallpike or side-lying test. If the patient met inclusion criteria, the opportunity for participation was offered after counseling the patient on the pathophysiology and treatment of BPPV. The American Institute of Balance uses a systematic approach to counseling patients with BPPV. Although different clinicians participated in this counseling, all clinicians used the same materials/handouts and essentially the same approach in terms of language. After informed consent, the DHI and UMAA were completed, the results of which represented the pretreatment condition data. The duration of time needed to complete the DHI and utility measures was approximately 10 minutes for each session.

For the RS, the participant rated his/her current dizziness on a visual analog scale from 0 to 100. A rating of 0 meant the person felt incapacitated by the dizziness, whereas a rating of 100 indicated a complete absence of dizziness. The participants moved a slider along the continuum until they reached the point that represented their perception. The UMAA then provided the numerical value. The utility score for the RS technique was calculated as the point along the RS representing the patient's perceived impact of his or her dizziness on HRQoL divided by 100. The schematic representation is shown in Figure 2.

During the SG task, the participant chose between two different options. One option was to live with the current

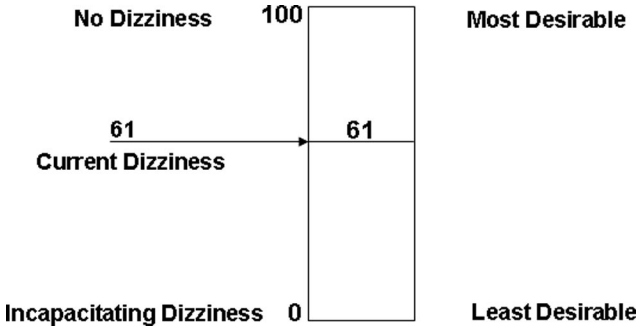

Fig. 2. Schematic representation of rating scale utility task. Patient rates current dizziness on scale with anchors of 0 indicating incapacitating dizziness (least desirable) to 100 indicating no dizziness (most desirable). Hypothetical patient rating of current dizziness is shown at 61.

dizziness for the rest of his or her life with the dizziness neither worsening nor improving. The second option was to take a magic pill with a chance of the dizziness completely going away and a chance of the dizziness completely incapacitating him or her. The participant selected between the two choices, and the percentage chance of experiencing incapacitating dizziness was varied adaptively by an initial step size of 50% and then by a step size of 25% until the "cannot choose" option was selected. The utility score for the SG technique was calculated as 1.0 minus the maximum chance of incapacitating dizziness the patient was willing to gamble for being dizzy free. The schematic representation is shown in Figure 3.

As an example, a person with poor HRQoL related to their BPPV might be expected to choose a higher possibility of incapacitating dizziness for a chance at living free of their current dizziness. A person whose BPPV had less impact on HRQoL would probably choose a relatively lower possibility of incapacitating dizziness to have a chance of living free of the current dizziness.

With the TTO technique, the participant again had to choose between two options. The participant could continue to live with the dizziness for the rest of his/her life followed by a natural death. For this option, the dizziness would neither improve nor worsen. The second option was that the dizziness went away immediately and the person lived without dizziness but for a shorter number of years followed by a natural death. The participant chose between the two

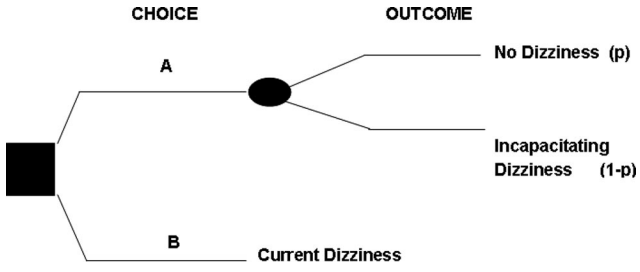

Fig. 3. Schematic representation of standard gamble utility task. Patient must choose between current dizziness (B) or an outcome (A) with a probability (p) of having no dizziness but also a probability ($1 - p$) of acquiring incapacitating dizziness.

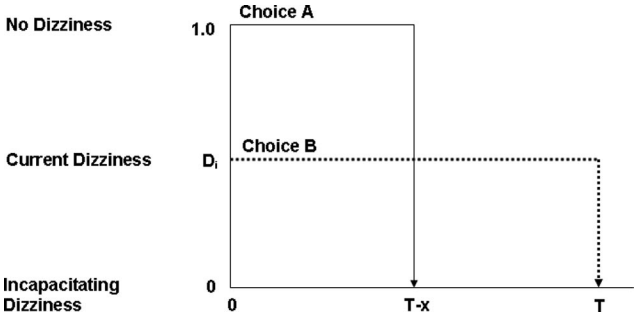

Fig. 4. Schematic representation of time tradeoff utility task. Patient must choose between (B) current dizziness (D_i) with typical life expectancy in years (T) or (A) no dizziness but with fewer years of life ($T - x$).

options while the number of years before death varied adaptively by an initial step size of 50% and then by a step size of 25% until the participant could no longer choose between the options. The utility score for the TTO technique was calculated as 1.0 minus the maximum number of years (as a percentage of the patient's calculated remaining life span) the patient was willing to trade off to be dizzy free. The schematic representation is shown in Figure 4. Similar to SG, a person with poor HRQoL related to their BPPV might be expected to choose to live a fewer number of years free of dizziness during the TTO task, while a person whose BPPV had less of an impact on HRQoL might be unlikely to trade many years of life since the dizziness has less of an impact.

The order of presentation of utility measures was randomized across participants and sessions to control for any potential order effects. Once finished, the UMAA computed the results and scores (utilities) for each subtest and displayed them on the screen. The results were written down on hard copy and also saved by UMAA to a data base for subsequent analysis. After completing the initial utility program, the participant was treated for BPPV with repositioning treatment maneuvers representing the current standard of care (Epley 1992; Roberts et al. 2006; Semont et al. 1988). Depending on the extent of evaluation, treatment was sometimes provided during this same appointment (but always after completion of the pretreatment UMAA). For patients who were not treated during that initial appointment, repositioning treatment always occurred within 1 week after the initial visit.

Initial treatment was the Semont liberatory maneuver, the canalith repositioning maneuver, or the Gans repositioning maneuver. As shown in Table 1, the Gans repositioning maneuver was selected by the clinician most often, followed by the canalith repositioning maneuver and the Semont liberatory maneuver. The purpose of this study was not to determine which treatments are most efficacious, so no attempt was made to control the type of treatment. Rationale for a particular treatment was left up to the clinician, and factors considered included body type of the patient, cervical range of motion, history of vertebrobasilar insufficiency, hip replacement, etc.

Second visit • A subgroup of 15 participants were tested at the initial evaluation and 1 week after the initial visit but before the treatment. During this visit, the UMAA and DHI were completed a second time to determine the stability of the utility program based on comparison with data from the initial visit.

Final visit • One week after treatment, all participants returned for a follow-up appointment and completed the UMAA and DHI to examine and compare each instrument's sensitivity to treatment. Patients then underwent re-evaluation with modified Hallpike or side-lying positioning to ensure that they were clear of the BPPV. If a patient was not clear, another treatment was performed. Additional data for the current investigation were not obtained at subsequent follow-up appointments for patients who remained positive for BPPV after initial treatment.

RESULTS

As shown in Table 1, 62% of the participants were clear of their BPPV when they returned for follow-up 1 week post-treatment. Another 25% of patients were clear of BPPV after a second treatment, whereas 13% required three or more treatments to be clear of BPPV. UMAA and DHI post-treatment data were only collected at the follow-up appointment after the initial treatment. Data from all participants were included in subsequent analysis, even those who were not clear of BPPV based on results of modified Dix-Hallpike or side-lying maneuver.

Three factors were analyzed in an effort to determine if the UMAA is an efficient method of measuring the HRQoL for patients with BPPV. These factors were stability, validity, and sensitivity of the utility values. Intraclass correlation coefficients were used to estimate stability of measures over time using the data of the 15-participant subgroup. The intraclass correlation coefficients are given in Table 2 for each utility and the DHI. These results are suggestive of excellent test stability (Rosner 1995).

Utility measures were compared with measures obtained with an established disease-specific health status measure (DHI) in an effort to determine the validity of the utilities obtained through the UMAA. Spearman's rho correlations between pretreatment utilities and pretreatment DHI, as well as post-treatment utilities and post-treatment DHI, were calculated. Pretreatment RS was significantly correlated with pretreatment DHI ($p = 0.001$, $r = -0.46$), as well as post-treatment RS and post-treatment DHI ($p < 0.001$, $r = -0.47$). Other significant correlations were observed between post-

TABLE 2. Stability and sensitivity data are shown for the Utility Measures for Audiology Application (UMAA) and Dizziness Handicap Inventory (DHI)

	UMAA			
Parameter	Rating scale	Standard gamble	Time tradeoff	DHI
Intraclass correlation coefficient	0.84	0.76	0.89	0.96
95% Critical difference	0.075	0.445	0.27	6.5
Participants exceeding critical difference	52	12	16	48

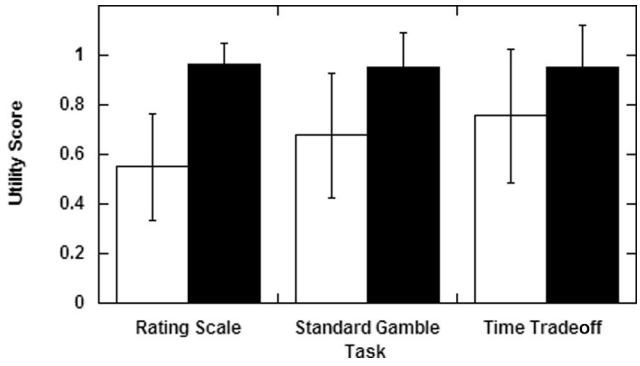

Fig. 5. Utility scores are provided for each UMAA task. Pretreatment utility is shown in white; post-treatment utility is shown in black. Error bars represent standard deviation.

treatment SG and post-treatment DHI ($p = 0.002$, $r = -0.41$) and between post-treatment TTO and post-treatment DHI ($p = 0.02$, $r = -0.32$). No other correlations were significant.

Results from utility measures were averaged, and pre- and post-treatment data are shown in Figure 5. Post-treatment utility scores are higher than pretreatment utility scores regardless of UMAA task. The Wilcoxon signed rank test was used to analyze changes in utility measures and the DHI from pre- to post-treatment. This nonparametric analysis was selected because the individual post-treatment data points did not have a normal distribution and the variance was much smaller compared with pretreatment data. A significant increase was observed in the ranked position of the RS results post-treatment for BPPV ($T = 51$, N = 52, $p < 0.001$). This was also observed for SG ($T = 41$, N = 52, $p < 0.001$) and TTO ($T = 31$, N = 52, $p < 0.001$). For the DHI, a significant decrease was observed in the ranked position of the results post-treatment for BPPV ($T = 51$, N = 52, $p < 0.001$). These results suggest that improvement in HRQoL post-treatment of PC-BPPV is measurable with both the UMAA and the DHI.

In addition to the Wilcoxon signed rank test results, critical difference data were determined. The 95% critical differences were obtained by examination of the distribution of retest difference scores for the utilities. These data are tabulated in Table 2. Critical difference values provide a normative reference for drawing inferences about changes in the perception of HRQoL after treatment of BPPV. For example, if the difference in utility score of an individual exceeds the values for the 95th percentile, then we can conclude with 95% confidence that perception of HRQoL has changed. The numbers of participants exhibiting a change for each utility and the DHI are also given in Table 2. A greater number of participants exceeded the 95% critical difference value for RS compared with SG and TTO. This value was comparable for RS and the DHI.

DISCUSSION

In order for an HRQoL measure to be clinically useful, it needs to be stable, valid, and sensitive. When evaluating evidence from a study using HRQoL measures or selecting an instrument for use in clinical practice, it is important to consider whether there is demonstrable evidence of these properties and if the results are relevant and can be clinically interpreted. It is also important to consider the feasibility of utility measures in regard to patient performance.

The present study determined intertest stability of utility measures in regard to dizziness. It is important that the techniques used for utility measurements (RS, SG, and TTO) meet the qualities that have been suggested of a good utility instrument. Rosner (1995) classified an intraclass correlation coefficient less than 0.4 as indicating poor reproducibility, between 0.4 and 0.75 as fair to good reproducibility, and 0.75 or greater as excellent reproducibility. Intraclass correlation coefficients observed in the present study were 0.84 for RS, 0.76 for SG, and 0.89 for TTO, demonstrating excellent stability. This is in agreement with the result of Lopez-Escamez et al. (2003), who reported Cronbach alpha coefficients of higher than 0.70 for both the SF-36 and the DHI.

The association between the DHI scores and the utilities obtained through the UMAA (particularly the RS subtest) supports the validity of the UMAA as a tool for measuring HRQoL. The moderate levels of correlation between the DHI and the RS technique of the UMAA were similar for pretreatment (−0.46) and post-treatment (−0.47). The SG and DHI were also moderately correlated, but only for post-treatment (−0.41) as was post-treatment TTO and DHI (−0.32). Lopez-Escamez et al. (2003) also determined the correlation between their SF-36 and DHI results. Similar to the current study, all the post-treatment SF-36 subscale scores were significantly correlated with DHI scores, but this was not the case for pretreatment SF-36 scores. Correlations ranged from approximately −0.30 to −0.50 for four of the eight SF-36 subscales pretreatment but from −0.50 to −0.70 across all eight of the post-treatment subscales. The correlation data suggest that HRQoL measures using both disease-specific utilities (UMAA) and generic health status measures (SF-36) are valid when compared with an established disease-specific health status measurement of dizziness (DHI). It also seems that the relationship among these measures is stronger post-treatment than pretreatment.

A possible explanation for the apparent difference between correlations before and after treatment with the DHI may be related to the intense nature of the symptoms of BPPV. When questioned, many patients with BPPV report that they made emergency room visits at the onset of the episodes of vertigo and express concern that they are experiencing cerebrovascular or myocardial infarction. On the other hand, some people live with the symptoms of BPPV for many years. Once BPPV has been cleared, the patient typically experiences no further symptoms. This may lead to post-treatment scores that are more homogeneous regardless of the measurement instrument. It is possible that pretreatment self-perceived HRQoL is more variable than post-treatment HRQoL, which may explain the differences in correlations with the disease-specific measure pre- versus post-treatment. In Figure 5, it can be observed that the variance for the post-treatment utilities is, on average, 46% of the variance seen in the pretreatment utilities. It is also possible that the decreased variance for post-treatment measures could reflect a ceiling effect for the UMAA. Comparison with Lopez-Escamez et al. (2003) data is difficult, because raw data are not provided for their study, which used the SF-36. However, in the study of Gans and Crandell (2000), the standard deviation of the pretreatment SF-36 data averaged 23% greater than their post-treatment data. This is in agreement

with our data for utilities and supports our suggestion that impact on HRQoL may be more variable before treatment.

Another consideration that may account for the correlation between RS and DHI pretreatment measures and slightly increased correlation post-treatment could be related to methodology. The DHI asks participants to answer questions specifically about their dizziness. For the RS, participants were asked to rate perception of their dizziness. These tasks seem more similar and could be more closely correlated than the TTO and SG techniques, which offer the participant choices about trading years of life or risking incapacitating dizziness to determine impact of dizziness on HRQoL.

Results from previous investigations (Gamiz & Lopez-Escamez 2004; Gans & Crandell 2000; Lopez-Escamez et al. 2003) and the present study indicate that patients with PC-BPPV feel that their dizziness has a negative impact on HRQoL. These patients then experience a measurable improvement in HRQoL after treatment. Specifically, Lopez-Escamez et al. (2003) compared pretreatment SF-36 subscale data from patients with BPPV with normal subjects, showing poorer HRQoL for all subscales except Vitality. After treatment, patients scored closer to norms, which indicated a significant improvement in HRQoL. This is in close agreement with findings of Gans and Crandell (2000), who also reported significant improvement in HRQoL for their participants after treatment of BPPV.

In the present study, post-treatment utilities were also significantly higher than pretreatment utilities, indicating improvement. In addition to the Wilcoxon signed rank test results, 95% critical differences were obtained. A greater number of participants exceeded the 95% critical difference value for RS compared with SG and TTO. This value was comparable for RS and the DHI. It would seem that these measures would therefore be more sensitive regarding the relief of BPPV symptoms post-treatment with a concomitant improvement in HRQoL.

Procedural Limitations

One potential procedural limitation of this study was the terminology used as part of the SG measurement task. Although the SG technique proved to be stable, valid, and sensitive post-treatment, it was not as efficient as the RS technique. Recall that the SG task requires participants to decide whether they would rather take a magic pill with a certain chance of eliminating or increasing their dizziness or not take the pill and continue to live with their current health state. Even though the participants understood that their decision was hypothetical, some participants taking multiple medications indicated that they did not want to add additional medication even with a 100% chance of eliminating their dizziness. This is likely to be a fairly common reaction among patients who might have multiple prescriptions for pharmacologic management. Patients with negative connotations regarding taking additional medications may perform the task differently than someone without these negative feelings or someone who is not on a multiple medication regimen. It is possible that this reaction to taking additional medication affected the SG results. Changing the terminology to avoid using "magic pill" may allow this type of patient to perform the task without this potential influence. In a more recent version of the UMAA, we have changed the terminology to "magic drink."

Utilities across Different Health Conditions

For the current study, we used three techniques (RS, SG, and TTO) for measuring HRQoL. Our results tend to suggest that the RS technique may offer certain advantages if one were to choose a single utility measure to study patients treated BPPV. Including all three techniques, however, may allow easier comparison with those HRQoL studies that used only a single utility technique to study another health condition or intervention. For initial studies of a given health condition or intervention, it should be useful to incorporate all three measures to facilitate such comparisons. This could be less important in subsequent or follow-up studies.

Although this study focused on the test efficiency of utility measures in patients treated for BPPV, these results offer the potential for comparing the HRQoL impact of BPPV with that of other health conditions. Utility measures have been developed from economic and decision theory to provide an estimate of patient preferences and to offer a way of comparing the costs of improving HRQoL across health states and interventions. These comparisons are critical for the planning of health care, accountability of treatment procedures, and policy making during a time of rising healthcare costs. Because the UMAA may be used as a preference-based HRQoL measure, future studies may be useful for comparison of audiology-specific conditions such as BPPV with other nonaudiologic conditions.

In the current study, utilities obtained from patients with BPPV before treatment ranged from 0.55 to 0.75 for the three procedures. This compares with TTO and SG utilities of 0.76 and 0.75, respectively, for patients with HIV/AIDS (Mrus et al. 2006). TTO utilities for patients with age-related macular degeneration are reported to be 0.63 (Bansback et al. 2007), also suggesting a fairly comparable HRQoL with patients with BPPV. SG utilities for patients with chronic hepatitis B ranged from 0.68 to 0.80 (Levy et al. 2008). These results would certainly suggest that in terms of HRQoL, BPPV has an effect similar to these other health conditions. Certainly, it should not be lost on the reader that utilities measured post-treatment of BPPV ranged from 0.95 to 0.97.

CONCLUSIONS

The primary purpose of this study was to determine if the UMAA is a stable, valid, and sensitive measure of the effects of BPPV and its treatment on HRQoL. Data were collected from 52 patients diagnosed with and treated for PC-BPPV. Results demonstrate that the UMAA is stable over time and sensitive to change in HRQoL post-treatment for BPPV. In addition, validity was demonstrated with results comparable to those obtained with the DHI, an established disease-specific health status measure. Specific conclusions that may be drawn from the current study are as follows:

1. BPPV has a negative effect on an individual's HRQoL;
2. Treatment of BPPV improves an individual's HRQoL;
3. Utility measures obtained with the UMAA are stable, valid, and sensitive to treatment of patients with BPPV; and
4. The UMAA demonstrates an improvement in HRQoL among patients with PC-BPPV post-treatment.

Since the UMAA can be used as a preference-based HRQoL measure, it may be useful for comparing audiology-specific

conditions such as BPPV with other nonaudiologic conditions, such as cardiovascular disease, diabetes, and depression.

ACKNOWLEDGMENTS

The authors thank Rachel McArdle, PhD, for assistance with statistical analyses and Brian Sawka for assistance with data collection.

Portions of this work were presented at the 2006 Convention of the American Academy of Audiology, Minneapolis, MN, and the 2006 Convention of the American Auditory Society, Scottsdale, AZ.

This work was based, in part, on an Audiology Doctoral Project completed by the third author in the Department of Communication Sciences and Disorders at the University of South Florida.

Address for correspondence: Richard A. Roberts, PhD, Alabama Hearing and Balance Associates, Inc., 113 E. Fern Avenue, Foley, AL 36535. E-mail: rroberts@hearingandbalance.net.

Received June 19, 2008; accepted January 27, 2009.

REFERENCES

Abrams, H. B., & Chisolm, T. H. (2000). Outcome measures: the audiologic difference. In H. Hosford-Dunn, R. J. Roeser, & M. Valente (Eds). *Audiology: Principles of Practice Management* (pp, 49–68). New York: Thieme.

Appiani, G., Catania, G., Gagliardi, M. (2001). A liberatory maneuever for the treatment of horizontal canal paroxysmal positional vertigo. *Otol Neurotol*, *22*, 66–69.

Bansback, N., Czoski-Murray, C., Carlton, J., et al. (2007). Determinants of health related quality of life and health state utility in patients with age related macular degeneration: the association of contrast sensitivity and visual acuity. *Qual Life Res, 16*, 533–543.

Bath, A., Walsh, R., Ranalli, P., et al. (2000). Experience from a multidisciplinary "dizzy" clinic. *Am J Otol, 21*, 92–97.

Beaton, D. E., & Schemitsch, E. (2003). Measures of health-related quality of life and physical function. *Clin Orthop Relat Res, 1*, 90–105.

Bergner, M., Bobbitt, R. A., Carter, W. B., et al. (1981). The Sickness Impact Profile: development and final revision of a health status measure. *Med Care*, *19*, 787–805.

Bozic, K. J., Rosenberg, A. G., Huckman, R. S., et al. (2003). Economic evaluation in orthopaedics. *J Bone Joint Surg, 85*, 129–142.

Cohen, H. (2004). Side-lying as an alternative to the Dix-Hallpike test of the posterior canal. *Otol Neurotol, 25*, 130–134.

Cohen, H., Kimball, K., Stewart, M. (2004). Benign paroxysmal positional vertigo and comorbid conditions. *ORL J Otorhinolaryngol Relat Spec*, *66*, 11–15.

Dix, R., & Hallpike, C. (1952). The pathology, symptomatology and diagnosis of certain common disorders of the vestibular system. *Ann Otol Rhinol Laryngol, 6,* 987–1016.

Epley, J. M. (1992). The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg, 107*, 399–404.

Gamiz, M., & Lopez-Escamez, J. (2004). Health-related quality of life in patients over sixty years old with benign paroxysmal positional vertigo. *Gerontology, 50,* 82–86.

Gans, R., & Crandell, C. (2000). Overview of BPPV: evaluating treatment outcomes with clinimetrics. *Hear Rev,* 50–54.

George, L. K. (2006). Perceived quality of life. In R. Binstock & L. George (Eds). *Handbook of Aging and the Social Sciences* (6th ed., pp, 320–336). Burlington, MA: Academic Press.

Herdman, S., Tusa, R., Zee, D., et al. (1993). Single treatment approaches to benign paroxysmal positional vertigo. *Arch Otolaryngol Head Neck Surg, 119*, 450–454.

Jacobson, G. P., & Newman, C. W. (1990). The development of the dizziness handicap inventory. *Arch Otolaryngol Head Neck Surg, 116*, 424–427.

Jacobson, G. P., Newman, C. W., Hunter, L., et al. (1991). Balance function test correlates of the Dizziness Handicap Inventory. *J Am Acad Audiol*, *2*, 253–260.

Karlberg, M., Hall, K., Quickert, N., et al. (2000). What inner ear diseases cause benign paroxysmal positional vertigo? *Acta Otolaryngol*, *120*, 380–385.

Katsarkas, A. (1999). Benign paroxysmal positional vertigo (BPPV): idiopathic versus post-traumatic. *Acta Otolaryngol*, *119*, 745–749.

Krahn, M., Bremner, K., Tomlinson, G., et al. (2007). Responsiveness of disease-specific and generic utility instruments in prostate cancer patients. *Qual Life Res*, *16*, 509–522.

Levy, A., Kowdley, K., Iloeje, U., et al. (2008). The impact of chronic hepatitis B on quality of life: a multinational study of utilities from infected and uninfected persons. *Value Health, 11*, 527–538.

Lopez-Escamez, J. A., Gamiz, M. J., Fernandez-Perez, A., et al. (2003). Impact of treatment on health-related quality of life in patients with posterior canal benign paroxysmal positional vertigo. *Otol Neurotol, 24*, 637–641.

Loughran, S., Gatehouse, S., Kishore, A., et al. (2005). Does patient-perceived handicap correspond to the Modified Clinical Test for the Sensory Interaction on Balance? *Otol Neurotol*, *24*, 637–641.

Mrus, J., Leonard, A., Yi, M., et al. (2006). Health-related quality of life in veterans and nonveterans with HIV/AIDS. *J Gen Intern Med, 21*, S39–S47.

Nease, R., Kneelang, T., O'Connor, G., et al. (1995). Variations in patient utilities for outcomes of management of chronic stable angina. *J Am Med Assoc, 273*, 1185–1190.

Parnes, L., & McClure, J. (1992). Free-floating endolymph particles: a new operative finding during posterior semicircular canal occlusion. *Laryngoscope, 102*, 988–992.

Perez, N., Martin, E., Garcia-Tapia, R. (2003). Dizziness: relating the severity of vertigo to the degree of handicap by measuring vestibular impairment. *Otolayrngol Head Neck Surg, 128*, 372–381

Roberts, R., & Gans, R. (2008). Background, technique, interpretation and usefulness of positional/positioning testing. In G. Jacobson & N. Shepard (Eds). *Balance Function Assessment and Management.* San Diego, CA: Plural Publishing.

Roberts, R., Gans, R., DeBoodt, J., et al. (2005a). Treatment of benign paroxysmal positional vertigo: necessity of post-maneuver patient restrictions. *J Am Acad Audiol*, *16,* 359–368.

Roberts, R., Gans, R., Kastner, A., et al. (2005b). Prevalence of vestibulopathy in benign paroxysmal positional vertigo patients with and without prior otologic history. *Int J Audiol*, *44,* 191–196.

Roberts, R., Gans, R., Montaudo, R. (2006). Efficacy of a new treatment maneuver for posterior canal benign paroxysmal positional vertigo. *J Am Acad Audiol, 17*, 598–604.

Roberts, R., & Lister, J. *Utility Measures for Audiology Application (UMAA)* [computer software]. Bay Pines, FL: VA Medical Center Bay Pines; 2005.

Rosner, B. (1995). *Fundamentals of Biostatistics* (4th ed., p, 682). Toronto: Wadsworth Publishing Company.

Schuknecht, H. (1969). Cupulolithiasis. *Arch Otolaryngol, 90*, 765–778.

Semont, A., Freyss, G., Vitte, E. (1988). Curing the BPPV with a liberatory maneuver. *Adv Otolaryngol Rhinol Laryngol, 42*, 290–293.

Stolk, E., & Busschbach, J. (2003). Validity and feasibility of the use of condition-specific outcome measures in economic evaluation. *Qual Life Res*, *12*, 363–371.

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item Short-Form Health Survey (SF-36): I—Conceptual framework and item selection. *Med Care, 30*, 473–483.

Wasserman, J., Aday, L., Begley, C., et al. (2005). Measuring health state preferences for hemophilia: development of a disease-specific utility instrument. *Hemophilia*, *11*, 49–57.

Whitney, S., Wrisley, D., Brown, K., et al. (2004). Is perception of handicap related to functional performance in persons with vestibular dysfunction? *Otol Neurotol*, *25*, 139–143.