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The development of the vanderbilt pediatric dizziness handicap inventory for patient caregivers (DHI-PC)

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ABSTRACT

Purpose: The purpose of the present investigation was to develop a psychometrically sound dizziness disability/handicap outcome measure for use with a pediatric population between 5 and 12 years of age.
Methods: Items comprising Phase 1 of the DHI-PC were created based on reports from parents, providers and patients. This version was administered to the caregivers (mean age 31.6 years, sd 5 years, 74 female) of 86 pediatric patients (mean age 9 years, sd = 2.83 years, 45 female). The caregiver's responses to each item were limited to "yes" (scored as 4 points), "sometimes" (scored as 2 points) or "no" (scored as zero points).
Results: A factor analysis for Phase 1 of the scale showed there to be a single factor (eigenvalue of 11.51) that explained 29% of the total variance. The results of Cronbach's alpha analysis enabled us to eliminate 15 items reducing the scale to 25 items (i.e. Phase 2 of the DHI-PC). Following elimination of the items with low item-total coefficients, the second phase of the DHI-PC was administered to 56 legal guardians (mean patient age 8 years, sd 4.65 years, 37 female). The analysis of this data again showed there to be a single factor (eigenvalue of 8.30) that explained 33% of the variance. Four items demonstrated item-total correlations less than 0.40. The final version of the DHI-PC has 21 items and a maximum score of 84%. Short-term test–retest reliability (i.e. three week interval between test and retest) of this DHI-PC was assessed for a subset of 10 patients (caregivers, mean age 38 years, sd = 7 years, 10 female). The results indicated the short-term, test–retest reliability to be strong ($r = 0.98$, $p \leq 0.001$).
Conclusion: The DHI-PC represents a new tool for assessing the impact of pediatric dizziness on the patient (as viewed through the perspective of the caregiver). This tool may be incorporated into the comprehensive evaluation of children suffering from dizziness.

1. Introduction

Dizziness and vertigo are common medical problems for adults. It has been estimated that dizziness and vertigo affect 4 million adults annually and are associated with emergency department (ED) costs in excess of 4 billion dollars once the costs of diagnostic testing have been included in the calculations [1]. The consequences of dizziness in adults can include an increased risk of falling and associated wrist, arm and hip fractures. However, the characteristics and consequences of dizziness and vertigo in children have only recently been described in the literature [1,2]. It is now known that children with sensorineural hearing loss have an increased incidence of vestibular impairments [3,4]. Childhood vestibular impairments can present as impaired gaze stability, headache, or delays in achieving motor milestones. In this regard, it has been estimated that 15% of school-aged children report a spell of dizziness or vertigo in the previous year [5]. It is believed that the 5 most common origins of dizziness and vertigo account for ~70% of cases and include migrainous vertigo (i.e. 17% of total dizzy patients), Benign Paroxysmal Vertigo of Childhood (i.e. 19% of total dizzy patients), otitis media (i.e. 3% of total dizzy patients), viral infection (i.e. of the vestibular nerves, or labyrinth; 14% of total patients), and head trauma (15% of total patients) [6]. It is significant to note that the first two disorders are migraine related. Currently, in most centers, it is an uncommon practice to screen children for vestibular impairments. Children with vestibular

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deficits that are congenital, acquired, and/or progressive may not report their symptoms and therefore intervention may be delayed [7,8].

The administration of self-report outcome measures has become routine in clinical settings. Self-report measures of dizziness disability/handicap have made it possible for clinicians to measure a dimension of disease (i.e. disability/handicap) that cannot be predicted with measures of vestibular system impairment [9]. When administered in a pre- and post-treatment paradigm, standardized outcome measures make it possible to determine not only when a change in condition has occurred but also whether the magnitude of the change exceeds a level that is statistically significant. One such measure is the Dizziness Handicap Inventory (DHI) that was developed by Jacobson and Newman [10]. This self-report measure was designed using a format identical to that of the Hearing Handicap Inventory for the Elderly [11], the Hearing Handicap Inventory for Adults [12], the Tinnitus Handicap Inventory [13] and the Headache Disability Inventory [14]. Characteristics of these devices that have gained wide acceptance amongst clinicians include: (1) they all consist of 25 items requiring no more than 5–10 min to administer, (2) answers are limited to "yes," "no," or "sometimes" and, (3) the minimum and maximum total scores range from 0% (i.e. indicating no self-report dizziness handicap) to 100% (i.e. indicating maximum self-report handicap) respectively.

It would be valuable for clinicians to have a measure of dizziness disability/handicap for use with pediatric patients (i.e. between the ages of 5 and 12 years of age) that could be administered as a parental proxy. Such an instrument might be used in a pre-post treatment paradigm to assess changes in health-related quality of life. However, for these young patients the caregiver would complete the questionnaire.

Accordingly, the purpose of the present investigation was to develop a psychometrically robust pediatric adaptation of the Dizziness Handicap Inventory for pediatric patients but completed by their caregivers (i.e. called the DHI-PC). There were two phases for this project that will be denoted as Phase 1 and Phase 2.

2. Methods

2.1. Phase 1 of DHI-P development

This investigation was approved by the Institutional Review Board (IRB) of Vanderbilt University (IRB# 140331). A pool of items comprising the initial version of the DHI-PC was generated based on patient reports to caregivers and health care providers as well as expert opinion of audiologists with over 60 years of experience in the assessment of dizzy patients across the age range. The original version of the DHI-PC consisted of 40 items selected to maximize both content validity and face validity. Each item was a question where the phrase "your problem" was used rather than a description of the dizziness. Replacing the words "dizzy," "vertigo," and "unsteady" with "problem" makes it possible to use the DHI-PC with a broad range of dizziness disorders (e.g. "Does bending over increase your child's problem?"). The response to each item was limited to "yes," (given a score of 4 points), "sometimes," (given a score of 2 points), and "no," (given a score of 0 points). This version of the DHI-PC had 40 items. To estimate the DHI-PC's reliability, the initial version was administered to 86 caregivers of pediatric patients accompanying their child to an appointment at the Bill Wilkerson Center, Division of Vestibular Sciences. All children included in the study had a history of dizziness or disequilibrium severe enough warrant "significant concern" from the caregiver. Included in the study were children between the ages of 4 and 12 years of age. Excluded from the investigation were children presenting with a diagnosed neurological disorder that could affect functional balance (e.g. cerebral palsy).

76 of the caregivers accompanying the children were female (88%). The mean age of the was 31.6 years (sd = 5.7 years) and the patients mean age was 9.12 years, sd 3.4 years, ages ranged from 4 to 12). The internal consistency reliability of this initial set of data was calculated.

2.2. Phase 2 of DHI-P development

Based on the results of the analysis of the Phase 1 DHI-PC, a pool of items was created comprising the second phase of the DHI-PC. The Phase 2 DHI-PC consisted of 25 items selected to ensure that the scale had both content and face validity. The second phase of the device was administered to 56 caregivers (i.e. mean age of patients was 8 years, sd 4.65 years, 37 female, ages ranged from 5 to 12).

The resulting dataset was tabulated with patients serving as rows and scores for individual items serving as columns. The data set was imported into SPSS. The internal consistency reliability of the data set was once again calculated.

2.3. Test–retest reliability

A group of 10 caregivers (10 females) ranging in age from 26 to 43 years (mean = 38 years, sd = 7 years) were administered the scale at two separate occasions (mean interval = 27 days, sd = 5 days) to determine test–retest reliability of the DHI-PC. The scale was administered in a face-to-face format on the morning of the patient's appointment, and then again within 1 month. The magnitude of random measurement error in test and retest scores can be assessed by administering the test within a relatively short time period [15].

3. Results

3.1. Phase 1

For the initial 40-item version of the instrument, Cohen's alpha and internal consistency reliability were calculated. To estimate alpha, we tabulated patients as rows and item scores as columns using SPSS. Then the internal consistency was calculated using Cronbach's α [16]. Item-total Pearson correlations were used to identify extraneous items in the first phase of the DHI-PC (i.e. items that were uncorrelated to the total scale score). Items having high item-total correlations are favorable because they represent the scale's content. Cronbach's α coefficient for the 40-item DHI-PC was 0.93, which is considered to be good [17]. A criterion of item-total correlation of $\leq$0.40 was used to eliminate inconsistent items prior to second phase version of the DHI-PC.

Next we performed a principal components analysis (PCA) to determine whether there exists a subscale structure within the 40-item DHI-PC. The PCA was conducted in SPSS (version 22) in an effort to identify, using statistical techniques whether there existed clusters of items that might form subscales for the DHI-PC. A scree plot of the principal components showed that a single large component (i.e. possessing an eigenvalue of 11.51) explained 29% of the total variance, and a second independent component explained only 9% of the variance. It was determined that the third and later components could be disregarded since their occurrence was no greater than chance.

3.2. Phase 2

Data from the 25 item Phase 2 version was tabulated with patients serving as rows and scores for individual items serving as columns and imported into SPSS. The internal consistency of the data was again calculated using Cronbach's α. The Cronbach's