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Review Article

# Discussion of the dizziness handicap inventory

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**Abstract.**
**PURPOSE:** A review of the Dizziness Handicap Inventory (DHI).
**NUMBER OF STUDIES:** Seventy-four studies.
**MATERIALS/METHODS:** Articles published between January 1990 and May 2012 were identified by searches in PubMed electronic database. Of the 227 articles meeting the inclusion criteria 74 were reviewed. These articles are discussed under nine topics; Reliability, validity and internal consistency of the original version of DHI, relationship between vestibular/balance tests and DHI, association between DHI and the other scales related to balance impairments, exploratory factor analysis of the DHI, screening version of DHI, translations of DHI into other languages, the role of DHI to assess the success of the treatment of balance disorder, DHI results in various vestibular disorders, general characteristics of DHI in patients with balance impairment.
**CONCLUSIONS:** Self reported measures represent unique pieces of the information important for the management of dizzy patients. DHI is the most widely used self reported measurement of patients with dizziness. It has been translated into fourteen languages, so it is widely accepted.

Keywords: Dizziness handicap inventory, vestibular disorders, vestibular rehabilitation

## 1. Introduction

Vertigo and imbalance are some of the most important symptoms with negative influence in the well-being of patients of both genders and different age ranges. Vestibular tests are inadequate for evaluating the impact of dizziness on quality of life [32]. The Dizziness Handicap Inventory (DHI) [31] was modeled after the Hearing Handicap Inventory for the Elderly [13]. The 25 item DHI was developed to evaluate the self perceived handicapping effects imposed by vestibular system disease. Items were subgrouped into three content domains representing functional, emotional and physical aspects of dizziness and unsteadiness. The DHI was developed in response to the lack of instruments designed to identify specific functional, emotional or physical problems associated with an individuals reaction to balance function impairment.

## 2. Materials-methods

DHI is the most widely used scale to assess the self perceived handicapping effects imposed by vestibular system disease. The selection of studies included in this review was restricted to those with a primary focus on the development, reliability and validity, psychometric properties, and translations into different languages of DHI. However, studies that focused on the rela-

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tionship between diagnosis and treatment of vestibular disorders and DHI were included. Articles published between January 1990 and May 2012 were identified by searches in PubMed electronic database. "Dizziness handicap inventory" was selected as the keyword. Of the 227 articles meeting the inclusion criteria 74 were reviewed. These articles were discussed under nine topics.

### 2.1. *Reliability, validity and internal consistency of the original version of DHI*

DHI was modeled after the Hearing Handicap Inventory for the Elderly [13] and was developed in three investigations. The preliminary form of the DHI was administered to 63 patients suffered from episodes of dizziness or unsteadiness. There were 25 males and 38 females included in this group. The mean age of the subjects was 49.4 ± 18.5 years. An initial pool of 37 items for the DHI was developed empirically from case-history reports of patients with dizziness. The 37 items comprising the preliminary version of the DHI were selected to ensure that the scale had both content and face validity. The primary goal in evaluating the prototype inventory was to establish probe categories each with high internal consistency and a minimum number of items to make the DHI a more clinically efficient instrument. The data were analyzed statistically. The Cronbach alpha coefficient analysis was employed to measure reliability based on internal consistency. The alpha coefficients were high for the total scale (0.91) and good for the subscales (0.74 to 0.87). The purpose of investigation one was to reduce the number of items on this scale based on the preliminary version of the inventory and maintain adequate internal consistency reliability. The corrected item total values of the 37 items showed that a number of items could be deleted from the preliminary version based on low corrected item-total correlations. A number of items from the preliminary version of the DHI were deleted because of their similarity in content. In the second investigation, the final version of the 25-item DHI underwent a randomization of questions and was administered to 106 patients suffered from episodes of dizziness or unsteadiness. This sample was divided into three subgroups based on the number of dizzy or unsteadiness episodes experienced by a patient over the past 12-month period. The results of this investigation were tabulated and analyzed using Chronbach's a coefficient. Pearson product-moment correlations were conducted to determine whether subject age had an effect on the DHI total and subscale scores and, thus, on the magnitude of self-perceived dizziness handicap. Results demonstrated that the age of the patients imposed no systematic effect on self-perceived handicap as indicated by the total DHI score ($r = 0.01$, $p = 0.89$), or the functional ($r < 0.01$, $p = 0.94$), emotional ($r \leqslant 0.01$, $p = 0.94$) or physical subscales ($r = -0.02, p = 0.87$). In the last investigation a group of 14 subjects were administered the scale at two separate occasions to determine test-retest reliability of the DHI. Pearson product-moment correlations were computed for the total DHI scores between the first and second administrations of the DHI. The test-retest reliability for the total score was excellent ($r = 0.97$, $p < 0.0001$). Correlation coefficients associated with the functional ($r = 0.94$), emotional ($r = 0.97$), and physical ($r = 0.92$) subscales were high and statistically significant ($p < 0.001$) [31].

### 2.2. *Relationship between vestibular/balance tests and DHI*

DHI scores were marginally high for patients with traumatic vestibulopathy, failing computerized dynamic posturography conditions [16]. DHI showed significant moderate negative Pearson product moment-correlation ($r > 0.35$, $p < 0.005$) to the sensory organization subtests of the platform posturography [32]. The subjects who reported less perception of handicap showed better functional reach results than those who reported more perception of handicap [29]. Patients who have total DHI scores lower than 49 showed significant correlations (Pearson r) with functional reach and single leg stance. Correlation (Pearson r) of single-leg stance with eyes open was stronger than eyes closed [29]. DHI was cross-correlated with balance function tests (ENG or rotation chair) [57]. One month after vestibular neuritis, head shaking sensory organization test results were more correlated with the DHI than sensory organization test [38]. Several studies showed strong correlation between DHI and computerized dynamic posturography [16,42], functional reach test [29], electronystagmography [32], dynamic gait index [68], head impulse test [46,49] and functional balance tests involving locomotion [46]. Single leg stance test [29,42], Timed Up and Go test [42], rotational chair [32], Sensory Organization subtests of the platform posturography [32], Romberg test [46], four square step test [70], sit to stand test [68], firm surface conditions on the Modified Clinical Test for Sensory Interaction on Balance (CTSIB) [65] and Smart Bal-

Table 1
Relationship between vestibular/balance tests and DHI

| Strong correlation | Moderate/weak correlation | No correlation |
|---|---|---|
| – Computerized dynamic posturography<br>– Functional reach<br>– Electronystagmography<br>– Dynamic gait index<br>– Head impulse test | – Single leg stance<br>– Timed up and go<br>– Rotation chair<br>– Sensory organization subtests of the platform posturography<br>– Romberg test<br>– Four square step test<br>– Sit to stand test<br>– Firm surface conditions on modified clinical test for the sensory interaction on balance test<br>– Smart balance master | – Foam surface conditions on modified clinical test<br>– for the sensory<br>– interaction on<br>– balance test<br>– Caloric responses<br>– cVEMP |

ance Master [41] showed moderate/weak correlation with DHI. Foam surface conditions on the modified CTSIB [65], caloric responses [49,56] and cVEMP [8, 17] were not correlated with DHI (Table 1).

### 2.3. *Association between DHI and the other scales related to balance impairments*

There was a strong correlation between the SF-36 (Medical Outcomes Study 36-item short-form health survey on quality of life) and DHI scores [35] but the DHI was more responsive to recover after vestibular rehabilitation than the SF-36 for patients with unilateral/bilateral peripheral vestibular dysfunction [47]. A high correlation between DHI and Hospital Anxiety and Depression Scale was found in patients with peripheral or central vestibular dysfunction [74]. A moderately strong negative correlation (Spearman Rank Order correlation coefficient) was found between the scores of the Activities Specific Balance Confidence Scale and DHI [66]. The Vestibular Disorders Activities of Daily Living Scale and the DHI were moderately correlated [36,37]. The VADL was more responsive to higher levels of impairment than the DHI. The Brazilian DHI showed moderate correlation with the WHO QoL scale [58]. Significant correlations ($p < 0.01$, $r = 0.73$) were found between the physical component of the SF-12 (12-item short-form health survey on quality of life) and all domains of DHI [73]. For the patients with vestibulopathy, positive moderate correlation was found between Visual Vertigo Analogue Scale and the total DHI scores [20]. In benign paroxismal positional vertigo patients, a moderate correlation was found between the grade of functional and emotional impact of the DHI and belief consequences of the disease (The Illness Perception Questionnaire) as well as anxiety levels of the patients (State-trait anxiety inventory) [43] (Table 2).

### 2.4. *Exploratory factor analysis of the DHI*

Factor analysis examines a correlation matrix in order to establish groups of variables for which strong correlations are found between items in a group but weak for those outside the group. Different factorial solutions were suggested in several studies. Their common result indicated that the DHI is likely multidimensional in nature but that the dimensions are substantially different from the functional, emotional, and physical disability subscales suggested by Jacobson and Newman [31]. One study [30] suggested a two factor solution comprising General Functional Limitations and Postural difficulties. In the other study, a three factor solution was obtained for the Spanish version of the DHI [55]. Factors were related to vestibular handicap, vestibular disability, and visuo-vestibular disability. In the Brazilian version of the DHI [58], a 3 factor solution was obtained: compromising mental structure, physical limitations and loss of function. A 3 factor solution was also obtained for the German version [21]: activity and participation limitations, emotional problems and, motion activity in everyday life. Also the Turkish [10] version showed a 3 factor solution: functional limitations, physical problems and, emotional problems.

### 2.5. *Screening version of DHI (DHI-S)*

The DHI-S is a 10-item scale that was designed to evaluate the effect of dizziness in shorter time than the original DHI. Scores on the DHI- S have a high correlation to the total score of DHI ($r = 0.86$). Test-retest reliability for the DHI-S was 0.95. DHI-S showed moderate correlation with computerized dynamic posturography. The DHI-S internal consistency reliability in elderly patients with BPPV was limited to the total score of the scale. Subscales showed low internal consistency [33].

Table 2
Association between DHI and the other scales related to balance impairments

| Strong correlation | Moderate/weak correlation |
|---|---|
| – Health Related Quality of Life (SF-36)<br>– Hospital Anxiety and Depression Scale | – Activities Specific Balance Confidence Scale<br>– Vestibular Disorders Activities of Daily Living Scale<br>– Vertigo Symptom Scale<br>– WHO Quality of Life Scale<br>– SF-12<br>– Visual Vertigo Analogue Scale<br>– Illness Perception Questionnaire<br>– State Trait Anxiety Inventory |



### 2.6. *Translations of DHI into different languages*

The DHI has been translated into 14 different languages: Dutch [44], French [3], Argentine [11], Brazilian [7], Chinese [19], German [1], Arabic [4], Hebrew [18], Turkish [26], Swedish [64], Spanish [54], Japanese [23], Italian [28] and, Norwegian [6]. In almost all studies the standard forward, backward, and pretest steps were used for translation. Translation of DHI into different language required cross cultural adaptation. The DHI has high adaptibility between different cultures. A lot of clinicians have been using this scale.

### 2.7. *The role of DHI to assess the success of the treatment of balance disorders*

In the literature there are a lot of studies which show the effect of treatment in patients with vestibular dysfunction. The main purpose of development of the DHI was to evaluate the success of the treatment in vestibular disorders. In patients with unilateral vestibular loss DHI scores showed significant improvement (DHI total score improved from 51.3 $\pm$ 19.3 to 20.1 $\pm$ 15.9, $p < 0.001$) after Cawthorne-Cooksey exercises [9]. DHI scores decreased sharply after 6 month vestibular rehabilitation period [37]. DHI documented changes after therapy exercises for chronic dizziness [57]. Supervised vestibular rehabilitation is more succesful than home based vestibular rehabilitation (DHI total score improved from 44.9 $\pm$ 26.8 to 28.7 $\pm$ 26.1, $p < 0.001$) [14]. Computerized dynamic posturography technique (DHI total was 61.3 $\pm$ 21.2 at baseline and 52.9 $\pm$ 27.5 after rehabilitation, $p = 0.07$) and optokinetic stimulation (DHI total was 59.0 $\pm$ 19.9 at baseline and 48.8 $\pm$ 28.4 after rehabilitation, $p = 0.24$) didn't improve DHI scores [50]. For most patients with vestibular schwannoma, DHI doesn't worsen after tumor excision [15]. After the gama knife surgery in vestibular schwannoma there were no significant changes in DHI (preoperative mean of DHI total score was 16.1 $\pm$ 20.0, postoperative mean of DHI total score was 14.5 $\pm$ 15.9, $p = 0.64$) [71]. Vestibular rehabilitation combined with cognitive-behavioral therapy provided significantly decreased (pretreatment DHI total was 44.0 $\pm$ 21.5 and posttreatment DHI was 34.0 $\pm$ 22.8, $p = 0.03$) [27] DHI scores [48]. Thai-Chi significantly improved DHI results [72]. For benign paroxismal positional vertigo patients 30 days after the particle repositioning maneuver DHI-S scores decreased [39,51,59]. After cognitive behavior therapy DHI showed significant reduction (pretreatment mean of DHI total score was 53.8 $\pm$ 20.4 and post-treatment mean of DHI total score was 26.8 $\pm$ 18.7, $p = 0.07$) [63].

### 2.8. *The DHI results for various vestibular disorders*

In patients with vestibular schwannoma tumor size, sex, and magnitude of preoperative canal paresis significantly affect the degree of change in DHI [62]. Age, the presence of central vestibular system abnormalities and the nature of the patient's principal presenting symptom have no effect on DHI result [62]. 66% of patients experienced moderate level of handicap [15]. No significant differences were found in DHI scores due to age, time interval after surgery, surgical approach and tumor size. Loss of vestibular function was not strictly associated with a long term deterioration of quality of life [15]. In benign paroxismal positional vertigo DHI scores are better than patients with Meniere's disease and vestibular neuritis [61]. The DHI can augment the clinician's history taking and assist in screening for and the diagnosis of BPPV [69]. Even after successful repositioning maneuvers residual subjective symptoms may be detected by the DHI [69]. For patients with unilateral peripheral vestibular loss no correlation was found between DHI scores and postural indicators for either direction of the platform [24]. Three months after acute unilateral peripheral vestibular loss, DHI scores decreased [25]. Vestibular neuritis patients were followed up 4–6 years, DHI physical subscore and total score was higher than healthy persons [49]. DHI total scores and physical subscale of bilateral vestibular loss patients were worse than unilateral vestibular loss [34].

### 2.9. General characteristics of the DHI in patients with balance impairment

Approximately 70% of dizziness patients have moderate or severe complaints [53]. The handicap perceived by patients is primarily caused by physical and functional factors and less by emotional factors [53]. The physical component of the DHI is significantly worse in older adults (ages between 60–80) [67]. Variables such as intensity and type of dizziness, presence of neurovegetatives symptoms are not significant for DHI score [15]. Elderly patients, female adults and patients with anxiety disorders have significantly higher DHI scores [12,15,22,52,53,60,65].

## 3. Discussion

The DHI is the most widely used self reported measurement of patients with dizziness. Items of the DHI do not evaluate the otological (hearing loss, fullness sense etc.) or neurovegetative (nausea, vomitting) symptoms which mostly accompany to vestibular symptoms. Self-care, however, is an important part of daily life activities. The DHI does not assess the effects of dizziness on self-care activities.

In vestibular pathologies which are characterized by attacks (Meniere's disease etc.) the period of the assessment affects score directly. Vertigo is the chief symptom for which people with Meniere's disease seek relief, and its effect on balance function is a key concern for patients in as much as they are unable to function normally in their daily activities. Typically in the early stages, vertigo attacks are usually infrequent but severe and the hearing returns toward normal after the vertigo spell subsides. In the later stages, vertigo intensity decreases, hearing remains poor, and unsteadiness increases. There is great variability in this typical clinical picture between patients, with some having prompt remission while others have a progressively worsening experience with unrelenting vertigo. While monitoring the progression and treatment in patients with Meniere a disease-specific health-related outcomes instruments also can be used.

## 4. Conclusion

Self reported measures represent unique pieces of the information important for the management of chronic dizzy patients. Vestibular handicap is not only evaluated with measurements of impairment and/or its severity.

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