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ORIGINAL PAPER

VALIDATION OF THE POLISH VERSION OF THE *DIZZINESS HANDICAP INVENTORY*

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Abstract

Background: The *Dizziness Handicap Inventory* (DHI) was established to assess the impact of dizziness and balance problems on the quality of life. The aim of the study was to validate the Polish version of DHI for patients with vestibular disorders. **Material and Methods:** Two hundred and thirty patients diagnosed with vestibular impairment and/or positional vertigo were included in the study. The mean age of the study group was 56.2 years (SD = 13.6). The factor structure (the principal component analysis – PCA), internal consistency (Cronbach's α), and discrimination ability (the receiver operating characteristic [ROC] curve) were examined. **Results:** A satisfactory internal consistency was found (Cronbach's α coefficient = 0.92), while no floor or ceiling effect was revealed. The *Dizziness Handicap Inventory* demonstrated a good ability to discriminate between patients with and without the handicap (sensitivity and specificity about 80%, the cutoff point = 56). In PCA a 3-factor solution was obtained, with the factors related to restrictions in daily life, positional symptoms and visual-vestibular symptoms, which was not in agreement with the subscales provided in the original version. **Conclusions:** The Polish version of DHI demonstrates satisfactory measurement properties and can be used to assess the impact of dizziness on handicap and the quality of life. The functional, emotional, and physical subscales were not confirmed. In particular, the functional subscale revealed no satisfactory internal consistency which provides an indication for further studies. Med Pr. 2019;70(5)

Key words: vertigo, validation, internal consistency, *Dizziness Handicap Inventory*, vestibular impairment, dizziness

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INTRODUCTION

The *Dizziness Handicap Inventory* (DHI) was established to assess the impact of dizziness and balance problems on the quality of live. At the beginning, DHI was designed for vestibular disorders [1], but over time it came to be used for patients with dizziness of other origins [2].

The *Dizziness Handicap Inventory* contains 25 items scored according to the possible responses, as 0 pt ("no"), 2 pts ("sometimes"), and 4 pts ("always"). A maximum of 100 pts indicates the most severe handicap. Originally, the questionnaire was divided into 3 subscales: items in the *Physical Subscale* (P) concern the activities which may trigger dizziness, items in the *Functional Subscale* (F) assess the extent to which dizziness decreases the ability to perform tasks, while items in the *Emotional Subscale* (E) focus on the "fear of" and negative feelings.

The original version of DHI demonstrated the high total score reliability and lower values of Cronbach's α coefficients for the subscales. The age of the patients had no effect either on the total DHI score, or on the *Functional*, *Emotional* or *Physical* subscales [1].

The original version of DHI was prepared in the English language. Translations to other languages usually require validation and cultural interpretation. The *Dizziness Handicap Inventory* has been translated into many languages, e.g., German [3,4], Norwegian [5], Brazilian [6], Spanish [7] and others. The main translation problem is the difficulty to reproduce the original structure of DHI.

As there had been no Polish validated version of DHI, the study was performed to validate the Polish version of DHI for patients with vestibular disorders.

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Population

The study group included 230 patients referred for diagnostic reasons, because of chronic vertigo/dizziness. Their medical problems had to be associated with a vestibular disorder, including peripheral vestibular impairment and/or benign paroxysmal positional vertigo (BPPV). Exclusion criteria were dizziness or balance problems due to musculoskeletal, cardiologic, neurologic or psychic disorders.

The mean age of the study group was 56.2 years (SD = 13.6) (range: 25–87), with 168 women and 62 men having been enrolled. The patients agreed to participate, and the study was approved by the Ethics Committee of the Nofer Institute of Occupational Medicine in Łódź (No. 17/2014).

The diagnostic procedure consisted of a detailed clinical history, a complete neurootological bedside examination and a battery of laboratory tests, which included tympanometry, pure-tone audiometry, sakkades, pursuit, optokinetic tests, gaze nystagmus, bithermal water caloric test and kinetic tests (sinusoidal pendular rotation at frequencies 0.04, 0.08, 0.1, 0.32 and 0.64 Hz) recorded with Ulmer videonystagmography (VNG). Neurological consultation and magnetic resonance imaging (MRI) were obtained if needed. This careful examination formed the basis for diagnosing vestibular disorders and excluding patients with dizziness and balance problems caused by other than vestibular diseases.

MATERIAL AND METHODS

The Polish version of DHI was completed by the patients before vestibular testing and medical interview. Questionnaires were filled out by the patients themselves, without any help of the clinic staff. The questionnaire was to be answered in a similar manner as in the original English version, i.e., "yes" (4 pts), "sometimes" (2 pts) or "no" (0 pts). The maximal total response was 100 pts. The 3 subscales defined in the original version were also used and contained identical items. The maximal response was 28 pts for the P subscale, and 36 pts for the F and E subscales. For the validity criterion, the gold standard test should be used. With there being no questionnaire for the dizziness handicap assessment in the Polish language, item No. 21 of DHI, which is a direct question about the handicap perception, was used to divide the study group into disabled people (the answer was "yes" or "sometimes") and those not feeling handicapped due to vertigo problems (answer "no").

Data analysis

The floor and ceiling effect was calculated. The assumption was that the floor or ceiling effect was present if > 15% achieved the lowest or highest possible score in a sample size of ≥ 50 subjects [8].

The Cronbach's α coefficient analysis was done to investigate the internal consistency between an individual item and all the remaining items in the DHI total scale and in every single subscale. The association between the single items and the DHI were estimated using Spearman's correlation coefficients. The values were interpreted according to Gill-Body [9]; values < 0.25 were considered to be weak, values 0.26–0.50 – fair, values 0.51–0.75 – moderate and values of ≥ 0.76 were considered to indicate a strong relationship. The Cronbach's α coefficient was to range 0.70–0.95.

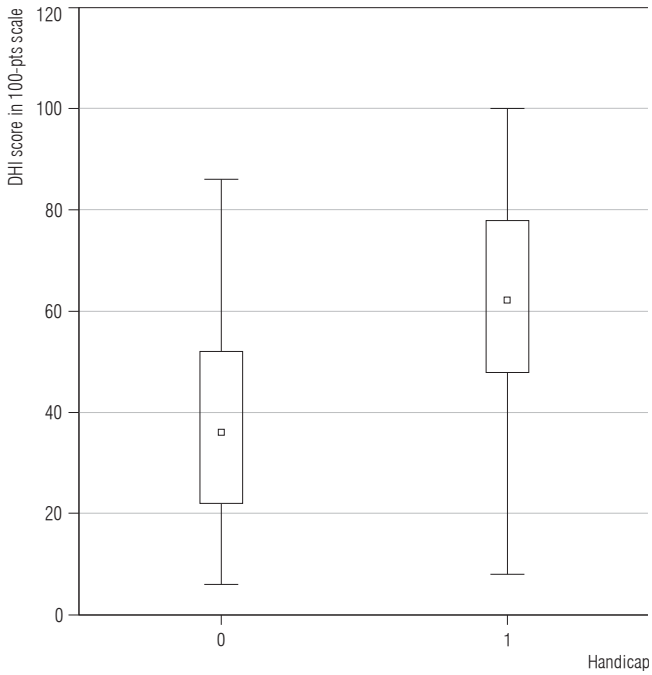
The median values of the DHI total scoring were compared between non-handicapped and handicapped subjects using the non-parametric U Mann-Whitney test. The receiver operating characteristic (ROC) curves and the area under the curve (AUC) were used to calculate the cut-off point for the handicap perception.

To evaluate different dimensions of DHI, the principal component analysis (PCA) was done. The principal component analysis was conducted on all the 25 items with varimax rotation. An initial analysis was run to obtain eigenvalues for each component in the data. In the analysis, factors > 1 (Kaiser's K-1 criterion) were extracted. Item loadings ≥ 0.5 were included.

RESULTS

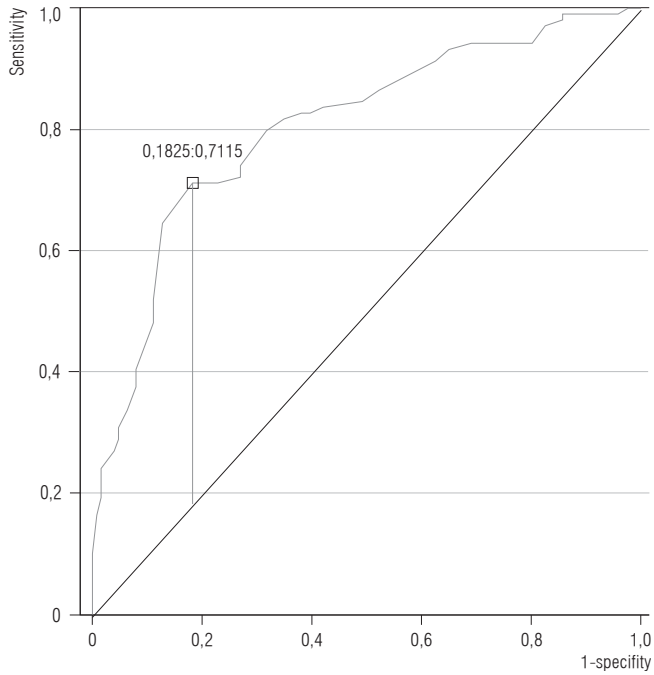
The scores of DHI ranged 4–100 pts, with 31 patients (13%) having < 20 DHI pts and 26 patients (11%) obtaining the highest scoring > 80 pts. No floor or ceiling effect was demonstrated. The Cronbach's α coefficient for the total scale was 0.920218. The covariance matrix showed no negative correlations but α increased when items F5 (0.920606) and P13 (0.921782) were deleted (Table 1). The correlation coefficients between the single items and the DHI total were fair and high, ranging 0.40–0.86, except items F5 (0.33) and P13 (0.27). The Cronbach's α coefficients for the 3 subscales were lower, i.e., P – 0.78471, F – 0,830249 and E – 0,844266. In the F subscale, α increased when item F5 (0,840282) was deleted.

DHI results were very poorly correlated with age, with the correlation coefficients amounting to 0.11 for the total score and to 0.14 for the F subscale, while no correlations were found for the P and E subscales (r = 0.09 and 0.06, respectively).



0 – patients who answered "no" to question 21 (not feeling the handicap due to vertigo problems), 1 – patients who answered "yes" or "sometimes" to question 21 (disabled).

Figure 1. The box-plot of non-disabled (0) and disabled patients (1), based on to the answers given to question 21 ("Because of your problem, do you feel handicapped?") *Dizziness Handicap Inventory* [1]



Youden index = 0.53, cut point = 56.00.

Figure 2. The receiver operating characteristic (ROC) curve – the sensitivity and specificity of the Dizziness Handicap Inventory [1] to reveal the handicap

Handicap

The handicap due to vertigo or dizziness was reported in 104 patients out of 230 included in the study group. The mean age of the handicap subgroup was 57 years (SD = 13.3), while the age of the non-handicap subgroup was 54 years (SD = 15.7) (p = 0.064247 in the U Mann-Whitney test). The mean values of the DHI total were 37 (95% CI: 34–40) for the non-handicap subgroup and 59 (95% CI: 60–67) for the handicap subgroup (p = 0.000000) (Figure 1).

The sensitivity and specificity of DHI to reveal the handicap were 77% and 78%, respectively (95% CI) (Figure 2). The AUC was 0.824.

Dimensions of DHI

An initial analysis (Figure 3) reveals the main 3 factors which explained 49.8% of the variance. The 3-factors solution is presented in Table 1. The Cronbach's α coefficients for factor F1 were lower – 0.898562 (min.–max: 0.883776–0.895298), for F2 – 0.898562 (min.–max: 0.724462–0.745178), and for F3 – 0.791315 (min.–max: 0.740036–0.756169), and they did not increase if any item was delayed.

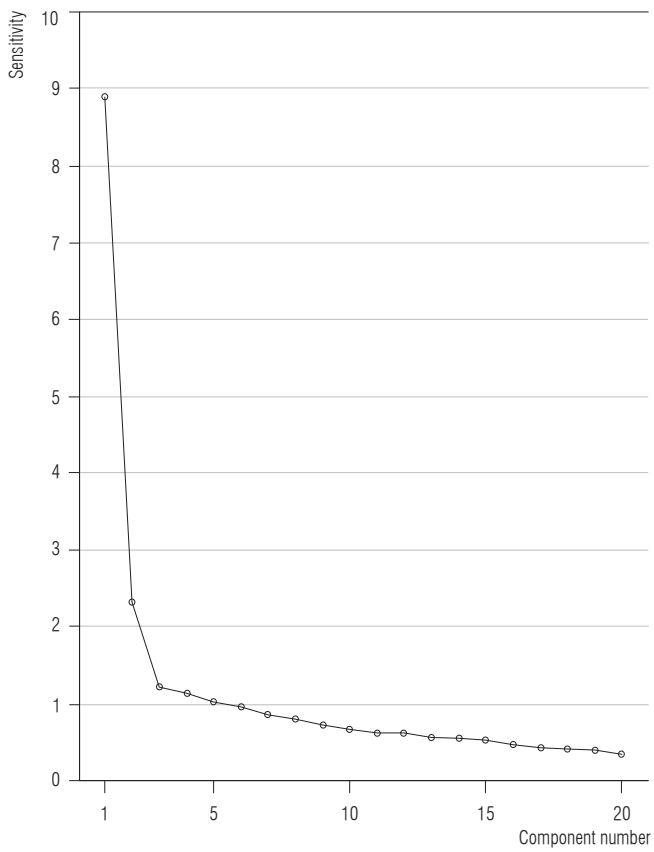


Figure 3. The graph plotting each eigenvalue against the factor

Table 1. The principal component analysis results

Item	Item short description	F1 Restrictions and disabilities due to vertigo (Cronbach's α = 0,89)	F2 Positional vertigo (Cronbach's α = 0,78)	F3 Visual dependence (Cronbach's α = 0,79)
Physical Subscale				
p1	looking up		0.62	
p11	quick head movements		0.62	
p13	turning over in bed		0.79	
p17	walking down sidewalks			0.67
p4	walking through supermarkets			0.75
p8	ambitious activities			0.60
p25	bending over	0.18	0.49	0.35
Functional Subscale				
f5	getting in/out of bed		0.76	
f14	strenuous house work		0.54	
f12	avoiding heights			0.57
f19	walking in darkness			0.58
f3	restrictions in travelling	0.63		
f6	restrictions in social activities	0.60		
f7	difficulties reading	0.51		
f16	walking by yourself	0.68		
f24	job/house responsibilities	0.65		
Emotional Subscale				
e9	afraid of leaving home alone	0.71		
e10	feeling embarrassed	0.66		
e15	afraid of being perceived as drunk	0.56		
e18	difficulty concentrating	0.65		
e20	afraid of staying home alone	0.63		
e21	handicapped	0.67		
e22	family relationships	0.51		
e23	feeling depressed	0.56		
e24	frustrated	0.24		0.46

DISCUSSION

The DHI was adapted to the Polish language following the method of cross-translation. Two interpreters translated the initial English version into the Polish language, following which the primary version was established with a neurootologist and re-translated into English. The pre-final version was verified in a healthy group before the final version was established. The report from translations and the test-retest assessment was published in the Polish language [10]. The Polish version was characterized by good agreement (using the Bland-Altman limit of agreement) and reliability (weighted Cohen's κ coefficient > 0.7), which is in compliance with the questionnaire quality criteria presented by Terwee et al. [8].

There were significant, but low, correlation coefficients between age and the DHI total score in the present study. The literature data are equivocal. Colnaghi et al. [11] found the relationships between age and the DHI total, and DHI subscales as well, whereas Tamber et al. [5] did not find any such correlations in spite of

the populations' similar age in both studies. The *Dizziness Handicap Inventory* also shows a good ability to discriminate between the participants who reported disability and those without any. The cut-off point is quite high (56 pts) as compared to Tamber et al. (29 pts) [5]. However, in the present study yes/no categories were produced by adding "sometimes" and "yes" answers from a 3-pts scale, while Tamber et al. used a 6-pts scale and added scores 0–1 and 2–6. The 6-pts scale may change the subjective criterion of disability.

In the present study, the easy use and reliability of the Polish version of DHI was confirmed. High and acceptable Cronbach's α values confirm a good internal consistency of the Polish version of DHI. However, 2 items which are specific for positional symptoms are poorly correlated with the questionnaire items. On the contrary, these items are highly correlated with the items which compose F2 in PCA.

The principal component analysis identified the 3-factors solution which was comparable to the original factor structure. However, PCA did not confirm the original P, F and E subscales. The principal component analysis indicated that the DHI was probably multidimensional in nature but the dimensions were substantially different from the functional, emotional, and physical subscales. In the present study, factor F1 included all the items from emotional subscale, combined together with the functional subscale items used to assess restrictions and disabilities due to vertigo. Factor F2 was constructed by means of the items important for positional vertigo, and factor F3 contained items mainly connected with visual dependence. In F2 and F3, items from the P and F subscales were mixed. Similar difficulties were previously described by other authors. For example, Perez et al. [7], in the Spanish version, identified factors connected with vestibular handicap, vestibular disability and visuo-vestibular disability, while Kurre et al. [4] preferred the 3-factors solution better explained by the International Classification of Functioning, Disability and Health (ICF) than by the original physical, functional and emotional assumptions. The study on the original version of DHI by Asmundson et al. [12] also did not support the validity of the original subscale structure of DHI, extracting such factors as disability in the activities of daily living, along with phobic avoidance and postural difficulties. Different results from the factor analysis may be connected with different analytical methods, translation problems or cultural differences, but they may also indicate certain limitations in the initial factor structure [12].

CONCLUSIONS

The authors developed a Polish version of the *Dizziness Handicap Inventory*, which demonstrates the satisfactory measurement properties and can be used to assess the impact of dizziness on handicap and the quality of life. The factor analysis did not confirm any division for the subscales. In particular, the functional subscale revealed no satisfactory internal consistency which provides an indication for further studies.

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