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Translation, cross-cultural adaptation and reliability of the German Version of the Dizziness Handicap Inventory

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Abstract

Objective: To translate the Dizziness Handicap Inventory into German (DHI-G) and investigate reliability, assess the association between selected items of the University of California Los Angeles Dizziness Questionnaire (UCLA-DQ) and the DHI-G and compare the scores of patients and healthy participants.

Design: Cross-sectional design.

Setting: Tertiary centre for vertigo, dizziness or balance disorders.

Subjects: One-hundred forty-one patients with vertigo, dizziness and unsteadiness associated with a vestibular disorder; mean age 51.5 (13.2) and fifty-two healthy individuals participated.

Interventions: Fourteen patients participated in the cognitive debriefing; one-hundred twenty-seven patients completed the questionnaires once or twice within one week.

Main measures: The DHI-G assesses disability caused by dizziness and unsteadiness; the items of the UCLA-DQ assess dizziness and impact on everyday activities. Internal consistency was estimated using Cronbach's alpha, reproducibility by calculating Bland-Altman's limits of agreement and Intraclass correlation coefficients (ICCs). Associations were estimated by Spearman's correlation coefficients.

Results: Patients filled out the DHI-G without problem and found their self-perceived disabilities mostly included. Cronbach's alphas for the DHI-G and the functional, physical and emotional subscales were 0.90, 0.80, 0.71 and 0.82. The limits of agreement were ± 12.4 points for the total scale (maximum 100 points). ICCs ranged from 0.90 to 0.95. The DHI-G correlated moderately with the question assessing functional disability (0.56) and fairly with the questions quantifying dizziness (0.43; 0.35). The DHI-G discriminated significantly between healthy participants and patients.

Conclusions: The DHI-G demonstrated good reliability and is recommended as a measure of disability in patients with dizziness and unsteadiness.

Introduction

The German National Telephone Health Interview Survey in 2003 demonstrated a lifetime 29.5% prevalence of dizziness or vertigo in the adult population of Germany. Vestibular vertigo accounted for a quarter of all reports of dizziness (1). This condition creates a public health care problem, as 80% of the affected individuals require medical help and interrupt their work or daily activities as a result of the symptoms (1).

In a systematic literature review, Hansson (2) showed evidence of the effectiveness of vestibular rehabilitation in patients with various causes of vertigo, dizziness or imbalance. For these patients several outcome measures are in use, e.g. to assess change of symptoms, vestibulometric values, visual acuity, balance performance, or walking abilities. However, none of these tests reflect the disabling effects of dizziness on everyday life (3). Several questionnaires measure this aspect: the Dizziness Handicap Inventory (DHI) (4), the University of California Los Angeles Dizziness Questionnaire (UCLA-DQ) (5), the Vestibular Disorders Activities of Daily Living Scale (6), the Vertigo Dizziness Imbalance Questionnaire (7), the Vertigo Handicap Questionnaire (8), and the Disability Rating Scale (9). Yet none of these questionnaires exist in a validated German version. Therefore, we decided to translate and cross-culturally adapt the DHI for use in German-speaking regions.

The DHI is a 25-item questionnaire that can be used by both physiotherapists and multiprofessional rehabilitation teams to list patient's problems, formulate intervention goals, and plan and evaluate therapy and/or rehabilitation programs. Furthermore, the DHI reflects the interaction between the health components as described by the WHO's International Classification of Functioning, Disability and Health (10) (Figure 1).

The primary purposes of this study were the translation and cross-cultural adaptation of the DHI into German (DHI-G) and the investigation of the reliability of the translated version. A further objective was to assess the degree of association

between the DHI-G and three items selected from the UCLA-DQ. We hypothesized that, in people with dizziness and unsteadiness, dizziness fairly (0.26 to 0.50), and limitations in daily activities moderately correlate (0.51 to 0.75) with the DHI-G. We also hypothesized that self-estimated disability rated as mild, moderate or severe will moderately correlate with the DHI-G. An additional objective was to compare the scores of the DHI-G of healthy participants with the scores of the patient groups composed according to the perceived level of disability.

Materials and Methods

Participants

Patients had to suffer for at least one month or longer from vertigo, dizziness or unsteadiness associated with a vestibular disorder. Further inclusion criteria were: age between 18 - 75 years, the ability to walk and to independently manage about 50% of the daily tasks and the ability to understand and speak German. Exclusion criteria were dizziness or unsteadiness exclusively due to cardiopulmonary diseases or musculoskeletal problems, severe paresis, spasticity, cerebellar ataxia, extrapyramidal diseases or sensory loss. Other exclusion criteria included diagnosed dementia, psychiatric disorders or blindness.

In the period of July 2007 – July 2008, participants were recruited. Patients were recruited from the Interdisciplinary Center for Vertigo & Balance Disorders, Departments of ENT, Neurology & Psychiatry at the University Hospital Zurich. All patients who were referred to the department were asked to participate in this study. If a patient agreed, fulfilled the inclusion/exclusion criteria and gave the written consent, he/she was included in the study. Healthy participants, mainly family members and friends of health care professionals, were included after giving written consent.

The positive authorization of the ethics committee of the Canton of Zurich was obtained in accordance with the Declaration of Helsinki.

Procedures

Professor GP Jacobson, who developed the DHI (4), gave his permission to produce a German version. The international guidelines for self-reported measures published by the American Association of Orthopaedic Surgeons Outcome Committee (11) were used for the translation and cross-cultural adaptation. Additional information from Wild et al. (12) was used to define the characteristics of the persons involved and to plan the number of patients for the investigation of the pre-final DHI-G.

The procedure of translation and cross-cultural adaptation consisted of six steps. The DHI was translated into German by two independent bilingual translators. During a meeting the two translators and AK synthesized the results of the German translations comparing them with the original version. This was followed by a back-translation into English by two independent bilingual persons who had no knowledge of the original DHI. A pre-final DHI-G was produced by an expert committee consisting of the four translators, DS, TG, and AK taking into account all translations, written reports, the original DHI, and the suggestions of Professor Jacobson. The pre-final DHI-G was tested by AK and TG by interviewing fourteen patients while they filled out the questionnaire. The objectives of the cognitive debriefing were to assess the comprehensibility of the pre-final DHI-G and to let the patients estimate the completeness of the questionnaire in percent: 100% was defined as the questionnaire comprises all of the self-perceived disabilities from dizziness or unsteadiness. The transcriptions of the patient interviews were analysed by AK, who wrote the final version of the DHI-G after clarifying the last few questions with the translators and Professor Jacobson.

The procedure of investigation reliability and validity of the DHI-G is shown in Figure 2. At baseline, all patients obtained a set of questionnaires together with an information letter and a pre-addressed and post-paid envelope by surface mail. The

set of questionnaires contained the DHI-G, a questionnaire collecting information about basic characteristics of the patients, the first three items of the UCLA-DQ and one question asking the patients to rate their level of disability as mild, moderate or severe. These four questions were planned for analysing their association with the DHI-G. The data of the first DHI-G (DHI-G 1) were planned for calculating internal consistency. Patients who were assumed to have a stable health condition received a second set of questionnaires, after the completed baseline set was sent back to TG and AK. This set contained the DHI-G 2 and a questionnaire asking the patient about self-perceived changes in their health status or in the severity of dizziness or unsteadiness since he/she filled out the first questionnaire set. After 40 analysable pairs of questionnaires had been collected for the calculation of reproducibility (13) consecutive patients had only to fill out the baseline questionnaire set. The procedure of collecting the questionnaires was controlled daily by TG or AK who reminded patients to return the questionnaires or clarified missing or unclear responses.

Healthy participants received a slightly adapted baseline questionnaire set to complete.

Measures

The DHI(4) is a 25-item questionnaire that was designed to help the patients rate their self-perception of disability from dizziness. A *yes* response yields a score of 4 points, *sometimes* 2 points, and *no* 0 points. The total score ranges from zero (no disability) to 100 (severe disability). The scale consists of a seven-item physical subscale, a nine-item emotional subscale, and a nine-item functional subscale. The original version of the DHI demonstrated good face validity, internal consistency (Cronbach's alpha: 0.72 – 0.89) and test-retest reliability ($r = 0.92 - 0.97$) investigated in a study population with different aetiology of dizziness and unsteadiness (4). Several translations and cross-cultural adaptations of the DHI

exist: a Dutch version (14), Chinese version (3), Swedish version (15), and Spanish version (16). All language versions showed good internal consistency and test-retest reliability.

The UCLA-DQ(5) consists of five items. Patients are asked to characterise their dizziness with regard to 1) frequency, 2) intensity, 3) impact on daily activities, 4) impact on quality of life, and 5) fear of dizziness. A Likert scale is used ranging from one *least severe problem* to five *most severe problem*. The total possible score ranges from five to 25. The reliability of the original version is unknown. Kammerlind et al (2005) (17) investigated the test-retest reliability of the Swedish version of the UCLA-DQ and reported intraclass correlation coefficients (ICCs) and corresponding 95% confidence intervals (CIs) of 0.89 (0.57-0.96) and 0.82 (0.58-0.93) for patients with acute unilateral or with central vestibular disorders, respectively.

Data Analysis

Descriptive statistics of the participants' characteristics were performed. To investigate possible ceiling and floor effects, the distribution in baseline scores of the DHI-G was analysed. Floor or ceiling effects are considered to be present if more than 15% of the respondents achieve the lowest or highest possible score (18).

Cronbach's alpha coefficient analysis and corrected item-total correlation (CI-TC) were done to investigate the internal consistency and the strength of the relationship between an individual item and all remaining items in the DHI-G total scale and in each of the three subscales (19).

Reproducibility was assessed by calculating the limits of agreement according to the method of Bland and Altman (20). Difference values between test (DHI-G 1) and retest (DHI-G 2) are plotted as a function of the mean of the test-retest scores for each subject. If the values are of the same distribution, the difference scores should be zero. For an instrument to have high repeatability, 95% of the difference scores should fall within \pm two standard deviations (SDs) of the zero difference score (21).

Furthermore, ICCs were calculated. ICCs concern the variation in the population (interindividual variation) divided by the total variation, which is the interindividual variation plus the intraindividual variation (measurement error), expressed as a ratio between 0 and 1 (22). The two-way random effect model, absolute agreement definition, single measure ICC (ICC 2/1) was chosen (23, 24). As a general guideline, it has been suggested that values above 0.75 are indicative of good reliability (25).

The association between the single items quantifying self-perceived dizziness, or functional disability and the DHI-G were estimated using Spearman's correlation coefficients. The values were interpreted according to Gill-Body (2000) (26): Values < 0.25 were considered to be weak, values from 0.26 - 0.50 fair, values from 0.51 - 0.75 moderate and values of 0.76 and higher were considered to indicate a strong relationship.

To compare the median of the DHI-G from the three patient groups with mild, moderate or severe disability, the Kruskal-Wallis Test was done followed by Mann-Whitney *U*-tests to assess the difference between each pair of the three groups. A Bonferroni correction was done resulting in a new critical level of significance at 0.0167 (27). The difference in the DHI-G total scores of healthy participants and patients with mild disability was analysed using the nonparametric Mann-Whitney *U*-test.

The analyses were computed using the SPSS version 12.0 computer software.

Results

Translation and cross-cultural adaptation

Patients

14 patients (eight men) with a mean (SD) age of 60.5 (14.13) years were included for the interviews. All patients had a vestibular disorder (eight a peripheral, five a

central vestibular disorder, one multifactorial causes of dizziness). The mean (SD) of the DHI-G total score and the functional, physical and emotional subscales were 46 (20.0), 19 (9.4), 12 (7.2), and 14 (7.8), respectively.

Production of the pre-final DHI-G

The translations of the DHI into German and the back-translations succeeded without major difficulties. During the meeting of the expert committee, in which the pre-final DHI-G was produced, the results of the main points of discussions were:

- (1) To replace in each question the word *problem* with *problems*. This decision was made because patients were asked to estimate their disability caused by (in the least) dizziness or unsteadiness.
- (2) That the deletion or addition of examples is necessary to make some questions clearer. Therefore the examples given in item P8 were deleted. The question asked for *ambitious activities* but the examples given did not seem ambitious to us. In item F12 examples were added to give the patients an idea what they could imagine with, *do you avoid heights?*

Results of patient interviews

All participants answered the questions of the pre-final DHI-G spontaneously in a way which was expected. Due to this, the comprehensibility of the DHI-G could be qualified as good. Patients estimated that the DHI-G comprised of 92%, on average, (range 50% - 100%) of their self-perceived disabilities. They mentioned the following aspects as possible missing domains (frequency of nomination): *specific driving functions* (n = 3); *activities of self-sufficiency* (n = 2), *specific job activities* (n = 2); *mobility activities like climbing a staircase* (n = 1) or *using a lift* (n = 1), or *further emotional aspects* (n = 3).

Reliability and aspects of validity

Participants

Baseline characteristics of the 127 patients are summarized in Table 1. Fifty-eight consecutive patients, who were assumed to have a stable health condition for the next two weeks, were asked to fill out the questionnaire twice. Data of 18 patients were excluded from the analysis of reproducibility because these patients reported a change in the severity of symptoms (22). As shown in Table 1, the subgroup of 40 patients for the test-retest study was comparable with the whole study population. Patients generally completely and correctly filled out the DHI-G. Only the response of one question needed to be clarified.

Fifty-two healthy participants (24 men) with a mean (SD) age of 46.8 (13.1) years participated.

Distribution of scores of the DHI-G

Table 2 shows the distribution of scores of all patients as well as of the subgroup of 40 patients for the test-retest study. The results demonstrate the comparability of the two groups.

We evaluated the floor and ceiling effect of the DHI-G total scale with respect to the limits of agreement which were $\pm 9.0 - 15.8$ points (Table 2). Out of 127 patients, 3.9% had a score of < 9 points and 14.2% a score of < 16 points. 2.4% had a score of > 91 points and 4.8% a score > 84 points. The results demonstrated no obvious floor and ceiling effect.

Internal consistency

The Cronbach's alpha coefficients for internal consistency were 0.90 for the DHI-G total scale and 0.80, 0.71 and 0.82 for the functional, physical and emotional subscales, respectively (Table 2). Within the total scale CI-TCs ranged from 0.27 (item E10 and P13) to 0.71 (item E21) (Table 3). The CI-TCs of the three subscales are also shown in Table 3. None of the CI-TCs fell under the recommended value of 0.20 (19).

Reproducibility of the DHI-G

The time interval between the administration of the two questionnaires was 5.5 (\pm 1.9) days. The calculation of the repeatability coefficients for the total scale and the functional, physical and emotional subscales showed that 35 (95%), 40 (100%), 39 (97.5%) and 38 (95%) of the differences of test-retest scores lie between 2 SDs. The Bland-Altman plot for the total scale is shown in Figure 3. Ninety-five percent of the differences lay between \pm 12.4 points (95% CI: \pm 9.0 – 15.8 points). The limits of agreement of the subscales can be seen in Table 2. This table also shows the ICCs with all values exceeding the recommended value of 0.75 (23).

Association

The association observed between the DHI-G and the single question quantifying self-perceived disability was moderate with a Spearman's correlation coefficient of 0.71. The association between the DHI-G and the third question of the UCLA-DQ quantifying the effect of dizziness on the patients' daily activities was clearly lower but still moderate (0.56) (Table 4). The associations of the DHI-G with the frequency of dizziness and the intensity of dizziness were fair (0.43 and 0.35). Table 4 shows that the extent of associations was similar regarding the functional or emotional subscale, whereas the associations with the physical subscale were always fair (0.26 – 0.44).

Group comparisons

Patients with self-estimated disability of mild ($n = 36$), moderate ($n = 62$) or severe degree ($n = 29$) differed significantly in their median values of the DHI-G total scale (Table 5). Medians (range) reported were 20 (0-60), 44 (14-88) and 66 (44-90), ($H(2) = 64.002$, $p: 0.000$). A similar pattern could be seen analysing the three subscales. Post hoc Mann-Whitney U -tests showed significant ($p < 0.001$) differences in the median values of the DHI-G total scale and the three subscales

between patients with mild and moderate and between patients with moderate and severe disability.

Comparing the scores of patients with mild disability and healthy participants showed that patients felt significantly more disabled than the healthy participants with $U = 48.5$ (DHI-G total scale) $U = 148.00$ (physical subscale), $U = 131.00$ (functional subscale), and $U = 240.50$ (emotional subscale) ($p < 0.001$).

Discussion

We translated and cross-culturally adapted the original DHI into German. In 127 patients we investigated internal consistency and some aspects of validity. In a subgroup of 40 patients we investigated reproducibility. Cronbach's alphas for the DHI-G total scale and the three subscales fulfilled the commonly accepted minimal standards of 0.70 for group comparisons (28) and were comparable with the results of the original English version (4). All CI-TCs exceeded the recommended minimal value of 0.2 (19). The calculation of the repeatability coefficients showed that 95-100% of the differences of test-retest scores of the DHI-G total scale, as well as the three subscales, lay between two SDs, a quality criteria formulated by the British Standards Institution (1979) (21). As hypothesized, the DHI-G total scale correlated moderately with self-perceived functional disability and fairly with dizziness. This was expected because functional disability and symptoms belong to different constructs (Figure 1). As assumed, the DHI-G discriminated between patients with a different extent of disability caused by dizziness and unsteadiness as well as between patients with mild disability and healthy individuals.

The Cronbach's alpha values of the different language versions of the DHI are quite similar. An explanation might be that translation and cross-cultural adaptation of the DHI is unproblematic, and that the internal consistency was investigated in comparable study populations. All studies included patients with peripheral vestibular disorders (PVD), central vestibular disorders (CVD) and to some extent

patients with multifactorial or unclear pathology of dizziness and unsteadiness. However, the ratio of the different patient groups differed. While the study populations of Perez et al. (2000) (16) and Vereeck et al. (2006) (29) included a higher percentage of patients with peripheral vestibular disorders (PVD) (259 [76.5%] and 179 [83.6%]), the composition of the Chinese population (3) seems to be more comparable with our study population, including 27 (38%), respectively 56 (44.1%) patients with PVD.

The limits of agreement which we demonstrated for the DHI-G total scale (12.4 points; 95%CI: 9.0 – 15.8) lie between the 12 points for the Dutch version (14) and the 18 points suggested by Jacobson and Newman (1990) (4) for the original version of the DHI. This, in spite of the fact that the time interval between the administrations of the two questionnaires in our study was longer compared to the (one day) interval in the other two studies. In contrast to our study, patients in the study of Vereeck et al (2006) (14) could clarify uncertainties with a health care professional during the administration of the questionnaires.

Our results are in accordance with the results of diverse studies which showed that the relationship of the DHI and dizziness tend to be low to fair (e.g. Perez et al., 2003 (30), Kammerlind et al., 2005 (17)), whereas the association with questionnaires targeting functional disability (e.g. the UCLA-DQ (5), the VADL (6), and the Activities-specific Balance Confidence Scale [ABC] (31)) is moderate to high.

In the introduction we mentioned some possible alternative questionnaires to the DHI. The VADL (28 questions, 10 point response scale) is according to Cohen et al. (2000) more responsive to higher levels of impairment than the DHI; however, it does not assess the important psychosocial and emotional consequences of dizziness. The VDI (36 items, 6 point Likert scale) is not used as often as the DHI in

clinical practice and research, probably needs more time to administer, and Duracinsky et al. (2007) (34) reported that responsiveness only appeared to be modest. Yardley (1999) (35) reported that the translation of the VHQ (22 items, 5 point Likert scale) into Spanish was problematic. Authors concluded that “a handicap scale with a simpler item content and format (such as the DHI) might therefore be a more suitable candidate for translation (p72).” Beside the results of the reliability and validity we find the advantages of the DHI are its simplicity, the relevance of the items for individuals with dizziness and unsteadiness, and that the questionnaire accounts for all health components as described by the ICF. As Jarlsäter et al. (15) discussed, the disadvantage of the DHI may be the three-point response scale, the partly global questions and that some patients miss aspects of self-perceived disability. These issues may limit the responsiveness of the DHI.

Within this study, a German version of the DHI was established and the reliability of this DHI-G was shown to be good. In a next step the internal validity should be investigated. Although three studies (32, 33, 29) did not support the validity of the original subscale structure, Vereeck et al. (2007) (29) showed a four-factor solution, in which the first three factors were similar to the original subscales. The investigation of further external validity is still pending, and, because the DHI is categorized as an evaluative measurement, responsiveness is important to assess.

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Contributors

AK: is the guarantor, initiated, designed and monitored the study and wrote the article.

CvG: attributed to the design of the study and revised the article critically for its content.

CB: contributed to the analysis of data and revised the article critically for its content.

TG: contributed to the design of the study, subject's recruitment, all the steps of the process of translating and adaptation of the questionnaire and revised the article critically for its content.

DS: co-initiated the study, contributed to the process of translation and adaptation of the questionnaire and revised the article critically for its content.

EdB: analysed and interpreted the data, revised the article critically for its content and gave the final approval of the version to be published.

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Table 1 Baseline characteristics of the total study population ($n = 127$) and the subgroup ($n = 40$) for the test-retest study

Characteristics of the patients	Total study population ($n = 127$)	Subgroup ($n = 40$)
Age (years) (mean (SD), range)	50.5 (13.1) 21 - 75	50.9 (13.6) 21 - 74
Gender (n, (%))		
male	49 (38.6)	17 (42.5)
female	78 (61.4)	23 (57.5)
Groups of diagnosis (n, (%))		
UPVD	45 (35.4)	10 (25)
BPVD	11 (8.7)	4 (10)
CVD	52 (40.9)	18 (45)
multisensory/ multifactorial	19 (15.0)	8 (20)
Duration of dizziness or unsteadiness (n, (%))		
> 1 month and maximum 6 month	37 (29.1)	8 (20.0)
> 6 month and maximum 12 month	15 (11.8)	7 (17.5)
> 12 month	75 (59.1)	25 (62.5)
Level of disability (n, (%))		
little	36 (28.3)	7 (17.5)
moderate	62 (48.8)	23 (57.5)
severe	29 (22.8)	10 (25.0)
Frequency of dizziness (UCLA; Question 1) (n, (%))		
rarely	13 (10.2)	4 (10.0)
sometimes	63 (49.6)	19 (47.5)
about half of the time	24 (18.9)	10 (25.0)
usually	17 (13.4)	4 (10.0)
always	10 (7.9)	3 (7.5)
Intensity of dizziness (UCLA; Question 2) (n, (%))		
very mild	6 (4.7)	2 (5.0)
mild	13 (10.2)	4 (10.0)
moderate	51 (40.2)	17 (42.5)
moderately severe	46 (36.2)	13 (32.5)
severe	11 (8.7)	4 (10.0)
Limitation in activity respectively participation (UCLA; Quest. 3) (n, (%))		
no effect at all	11 (8.7)	3 (7.5)
continuing out all activities but with allowance for the dizziness	26 (20.5)	8 (20.0)
continuing most of the activities	52 (40.9)	18 (45.0)
continuing some of the activities	30 (23.6)	9 (22.5)
unable to continue any of the activities	8 (6.3)	2 (5.0)

SD, standard deviation; UPVD, unilateral peripheral vestibular dysfunction; BPVD, bilateral peripheral vestibular dysfunction; CVD, central vestibular dysfunction; multisensory/ multifactorial causes of dizziness; UCLA-DQ, University of California Los Angeles - Dizziness Questionnaire

Table 2 Distribution of scores of the DHI-G 1 & DHI-G 2 in the total study population ($n = 127$) and the subgroup ($n = 40$) for the test-retest study. Results of the analysis of reliability: internal consistency (Cronbach's alpha) and reproducibility (Limits of agreement and ICCs)

	<i>n</i>	DHI-G 1		Cronbach's alpha	<i>n</i>	DHI-G 2		Mean differences & limits of agreement			ICC 2/1 (95% CI)
		Median (range)	Mean (SD)			Median (range)	Mean (SD)	Mean (SD) 95% CI	Lower limit (95% CI)	Upper limit (95% CI)	
Internal consistency											
DHI-G total scale ^a	127	44 (0 – 90)	44.5 (21.6)	0.90	58	45 (4 – 96)	43.7 (20.4)	2.6 (7.3)			
Functional subscale ^b	127	18 (0 – 34)	16.5 (9.2) ⁱ	0.80	58	16 (0 – 36)	15.9 (8.9)	1.0 (4.0)			
Physical subscale ^c	127	16 (0 – 28)	13.9 (6.9) ⁱ	0.71	58	16 (0 – 28)	14.3 ⁱ (6.8) ⁱ	0.4 (3.1)			
Emotional subscale ^d	127	12 (0 – 36)	13.9 (8.6) ⁱ	0.82	58	13 (0 – 34)	13.5 (8.3)	1.1 (3.4)			
Reproducibility											
DHI-G total scale ^a	40	44 (12 – 90)	46.4 (20.8)		40	45 (6 – 96)	44.6 (21.9)	1.8 (6.2)	-12.4	12.4	0.95
Functional subscale ^b	40	18 (2 – 34)	16.8 (8.5)		40	16 (0 – 36)	16.4 (9.5)	0.4 (3.2)	-6.2	6.2	0.94
Physical subscale ^c	40	16 (4 – 24)	14.3 (6.0) ⁱ		40	16 (0 – 28)	14.1 ⁱ (7.0) ⁱ	0.2 (3.0)	-6.0	6.0	0.90
Emotional subscale ^d	40	16 (0 – 36)	15.2 (10.0)		40	13 (0 – 34)	14.0 (9.1)	1.2 (3.3)	-6.6	6.6	0.93
								0.1 – 2.3	(-8.5 - -4.8)	(4.8 - 8.5)	(0.87 - 0.97)

DHI-G, Dizziness Handicap Inventory – German version; SD, standard deviation; CI, confidence interval

^a Maximum score of the DHI-G: 100 points; higher scores mean more disability

^b Maximum score of the functional subscale: 36 points

^c Maximum score of the physical subscale: 28 points

^d Maximum score of the emotional subscale: 36 points

ⁱ Kolmogorov-Smirnov test: a normal distribution cannot be assumed.

Table 3 Corrected item-total correlation coefficients of the DHI-G and the original version of the DHI

Item	DHI: Questions	DHI (n = 106)	DHI-G (n = 127)	DHI-G Functional subscale	DHI-G Physical subscale	DHI-G Emotional subscale
P1	Does looking up increase your problem?	0.54	0.32		0.47	
E2	Because of your problem, do you feel frustrated?	0.34	0.51			0.59
F3	Because of your problem, do you restrict your travel for business or recreation?	0.76	0.61	0.60		
P4	Does walking down the aisle of a supermarket increase your problem?	0.39	0.48		0.40	
F5	Because of your problem, do you have difficulty getting into or out of bed?	0.50	0.41	0.32		
F6	Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing, or to parties?	0.69	0.72	0.71		
F7	Because of your problem, do you have difficulty reading?	0.44	0.36	0.36		
P8	Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?	0.54	0.67		0.51	
E9	Because of your problem, are you afraid to leave your home without having someone accompany you?	0.43	0.49			0.49
E10	Because of your problem, have you been embarrassed in front of others?	0.46	0.27			0.33
P11	Do quick movements of your head increase your problem?	0.51	0.41		0.59	
F12	Because of your problem, do you avoid heights?	0.49	0.42	0.38		
P13	Does turning over in bed increase your problem?	0.43	0.27		0.32	
F14	Because of your problem, is it difficult for you to do strenuous housework or yard work?	0.58	0.69	0.68		
E15	Because of your problem, are you afraid people may think you are intoxicated?	0.30	0.48			0.43
F16	Because of your problem, is it difficult for you to go for a walk by yourself?	0.62	0.57	0.58		
P17	Does walking down a sidewalk increase your problem?	0.58	0.46		0.26	
E18	Because of your problem, is it difficult for you to concentrate?	0.49	0.51			0.47
F19	Because of your problem, is it difficult for you to walk around your house in the dark?	0.48	0.32	0.25		
E20	Because of your problem, are you afraid to stay home alone?	0.27	0.37			0.39
E21	Because of your problem, do you feel handicapped?	0.41	0.71			0.67
E22	Has your problem placed stress on your relationship with members of your family or friends?	0.46	0.60			0.62
E23	Because of your problem, are you depressed?	0.41	0.63			0.71
F24	Does your problem interfere with your job or household responsibilities?	0.56	0.66	0.61		
P25	Does bending over increase your problem?	0.57	0.32		0.42	

DHI, original version of the DHI; DHI-G, Dizziness Handicap Inventory – German version

Table 4 Association between the DHI-G and one question quantifying self-estimated disability, and three selected items of the UCLA-DQ

	Level of disability ^a	Limitation of daily activity / participation (UCLA-DQ, question 3) ^b	Frequency of dizziness (UCLA-DQ, question 1) ^b	Intensity of dizziness (UCLA-DQ, question 2) ^b
DHI-G total score	0.71**	0.56**	0.43**	0.35**
Functional subscale	0.72**	0.56**	0.39**	0.36**
Physical subscale	0.44**	0.34**	0.31*	0.26**
Emotional subscale	0.66**	0.56**	0.40**	0.31**

DHI-G, Dizziness Handicap Inventory – German version; UCLA-DQ, University of California Los Angeles - Dizziness Questionnaire

^a three point response scale

^b five point response scale

Values are Spearman's correlation coefficients: ** correlation is significant at the 0.01 level (1-tailed); * correlation is significant at the 0.05 level (1-tailed)

Table 5 Comparison of the distribution of scores in healthy participants and patients with mild, moderate or severe disability caused by dizziness and unsteadiness

	Healthy participants (<i>n</i> = 52)	Patients with mild disability (<i>n</i> = 36)	Patients with moderate disability (<i>n</i> = 62)	Patients with severe disability (<i>n</i> = 29)
Age (years) mean (SD)	46.7 (13.1)	49.0 (15.2)	51.5 (12.2)	50.2 (13.9)
DHI-G total score ^a median (range)	0 (0 – 6)	20 (0 – 60)	44 (14 – 88)	66 (44 – 90)
Functional subscale ^b median (range)	0 (0 – 2)	6 (0 – 22)	18 (0 – 34)	26 (16 – 34)
Physical subscale ^c median (range)	0 (0 – 6)	8 (0 – 22)	16 (0 – 28)	20 (6 – 28)
Emotional subscale ^d median (range)	0 (0 – 2)	6 (0 – 22)	12 (2 – 32)	22 (12 – 36)

^a Maximum score of the DHI-G: 100 points; higher scores mean more disability

^b Maximum score of the functional subscale: 36 points

^c Maximum score of the physical subscale: 28 points

^d Maximum score of the emotional subscale: 36 points

Figure legends

Figure 1 Explaining the objectives of the Dizziness Handicap Inventory with the model of the WHO's International Classification of Functioning, Disability and Health (ICF)

Figure 2 Overview of the procedure of the investigation of the reliability and validity of the DHI-G

Figure 3 Bland-Altman plot of the DHI-G total scale. The outer horizontal lines represent the limits of agreement which are defined as 2-times the standard deviation of differences. The DHI-G total scale met the definition of the repeatability coefficient from the British Standards Institution (1979); 38 of 40 differences (95%) lie between the 2 SDs.

Figure 1

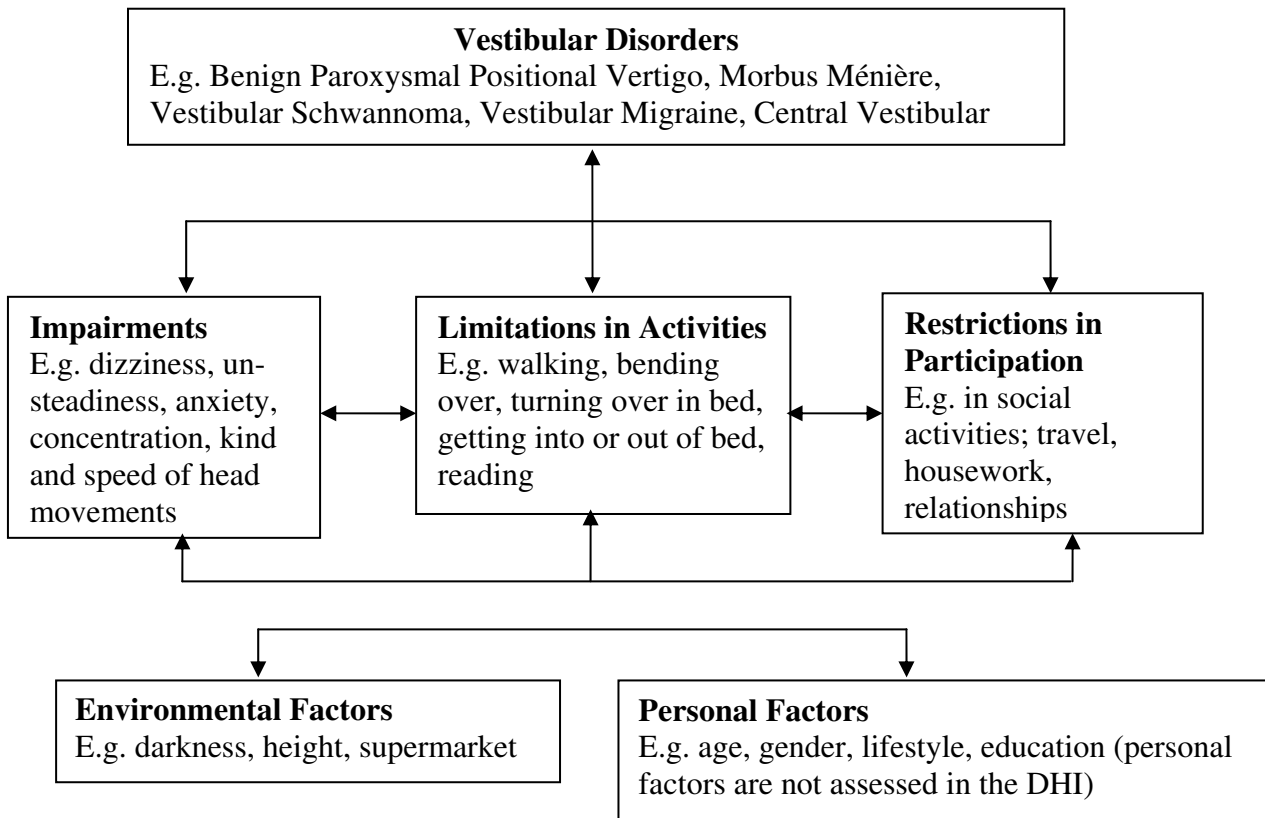


Figure 2

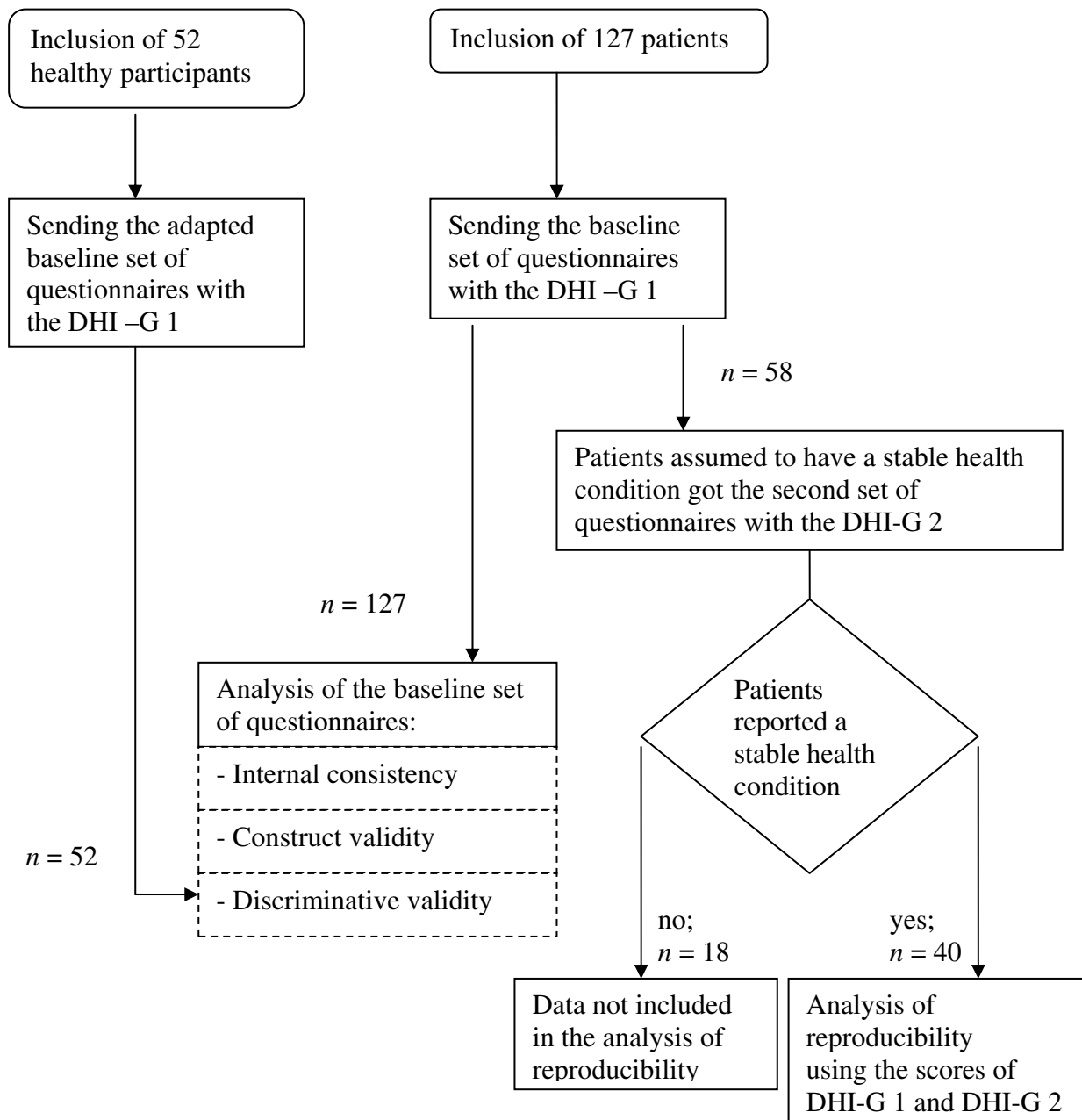
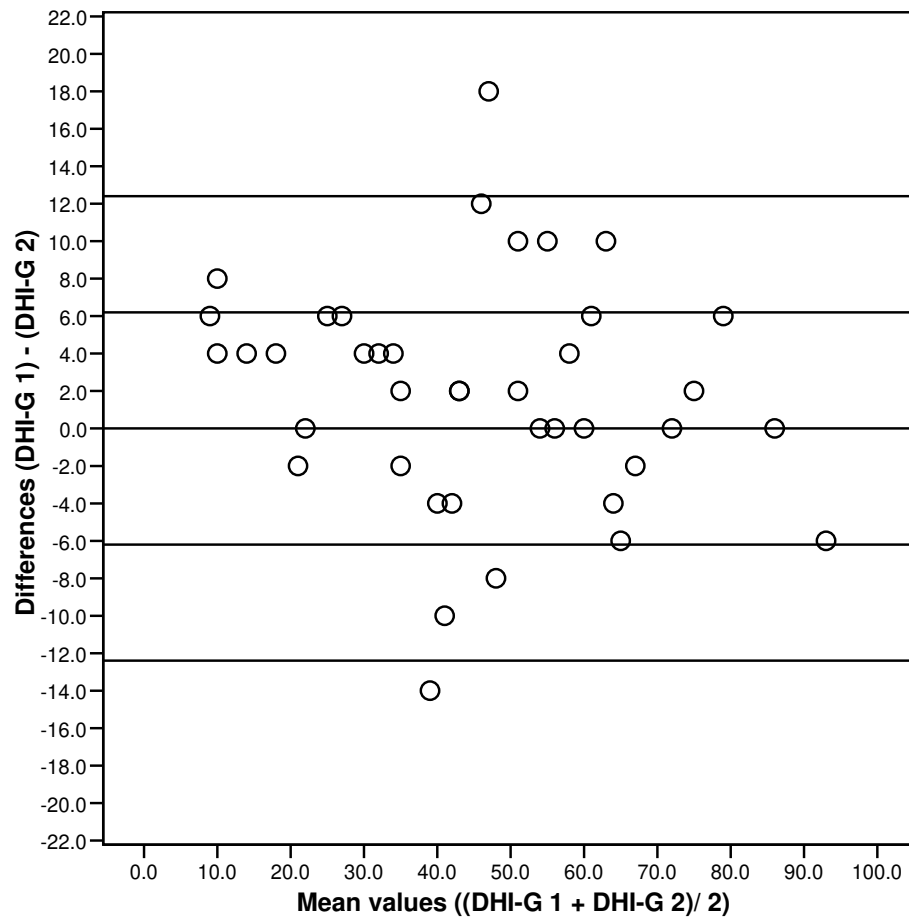


Figure 3



Appendix: Dizziness Handicap Inventory – German Version (DHI-G)

Anleitung:

Dieser Fragebogen dient dazu, die Probleme herauszufinden, die Sie wegen Ihres Schwindels oder Ihrer Gleichgewichtsprobleme haben können. Beantworten Sie bitte jede Frage entweder mit „ja“, „nein“ oder „manchmal“. Beantworten Sie jede Frage nur in Bezug auf Ihr Schwindel- oder Gleichgewichtsproblem.

- P1 Verstärken sich Ihre Probleme, wenn Sie nach oben schauen?
- E2 Fühlen Sie sich wegen Ihrer Probleme frustriert?
- F3 Schränken Sie wegen Ihrer Probleme geschäftliche oder private Reisen ein?
- P4 Verstärken sich Ihre Probleme, wenn Sie einen Gang im Supermarkt entlang gehen?
- F5 Haben Sie wegen Ihrer Probleme Schwierigkeiten beim ins Bett gehen oder beim Aufstehen aus dem Bett?
- F6 Schränken Ihre Probleme Sie deutlich ein, an gesellschaftlichen Aktivitäten teilzunehmen (z.B. auswärts essen gehen, Einladungen folgen, zu Parties gehen, ins Kino gehen, Theater oder Konzerte besuchen)?
- F7 Haben Sie wegen Ihrer Probleme Schwierigkeiten beim Lesen?
- P8 Verstärken sich Ihre Probleme bei anspruchsvolleren Aktivitäten z.B. im Sport, beim Tanzen oder bei Hausarbeiten?
- E9 Haben Sie wegen Ihrer Probleme Angst, das Haus ohne Begleitung zu verlassen?
- E10 Sind Sie wegen Ihrer Probleme schon einmal in eine peinliche Situation geraten?
- P11 Verstärken schnelle Kopfbewegungen Ihre Probleme?
- F12 Meiden Sie die Höhe wegen Ihrer Probleme (zum Beispiel: Berge, Hochhaus, Leiter, Gerüst)?
- P13 Verstärkten sich Ihre Probleme, wenn Sie sich im Bett drehen?

- F14 Haben Sie wegen Ihrer Probleme Schwierigkeiten, anstrengende Haus- oder Gartenarbeit zu erledigen?
- E15 Befürchten Sie, dass andere Leute wegen Ihrer Probleme denken, Sie seien betrunken?
- F16 Haben Sie wegen Ihrer Probleme Schwierigkeiten, alleine spazieren zu gehen?
- P17 Verstärken sich Ihre Probleme, wenn Sie auf einem Trottoir/Bürgersteig gehen?
- E18 Ist es wegen Ihrer Probleme schwierig für Sie, sich zu konzentrieren?
- F19 Ist es wegen Ihrer Probleme für Sie schwierig, sich im Dunkeln in Ihrer Wohnung zu bewegen?
- E20 Haben Sie wegen Ihrer Probleme Angst, alleine zu Hause zu bleiben?
- E21 Fühlen Sie sich wegen Ihrer Probleme behindert/ eingeschränkt?
- E22 Belasten Ihre Probleme die Beziehung zu Familienmitgliedern oder Freunden?
- E23 Fühlen Sie sich auf Grund Ihrer Probleme deprimiert?
- F24 Werden Sie durch Ihre Probleme beeinträchtigt, Ihre Aufgaben im Beruf oder Haushalt wahrzunehmen?
- P25 Verstärken sich Ihre Probleme, wenn Sie sich nach vorne beugen?