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ASSESSMENT AND VESTIBULAR REHABILITAION IN PATIENTS WITH UNILATERAL PERIPHERAL VESTIBULAR DISORDERS

A DISSERTATION SUBMITTED TO THE COUNCIL OF THE COLLEGE OF MEDICINE AT UNIVERSITY OF SULAIMANI IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN OTOLARYNGOLGY

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Certifications

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Examining Committee Certification

We, the examining committee, certify that we have read this dissertation entitled "**Assessment and Vestibular Rehabilitation in Patients with Unilateral Peripheral Vestibular Disorders**" and have examined the candidate (**Sherko Saeed Fathullah Zmnako**) in its context and in our opinion it is adequate as a dissertation for the degree of Doctor of Philosophy in Otolaryngology.

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Dedication

In memory of my parents, I dedicate this dissertation, with love and eternal appreciation.

Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other University. This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration, except where specifically indicated in the text.

Sherko Saeed Fathullah Zmnako

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List of publications related to this dissertation

1. Zmnako SSF, Chalabi YI. Reliability and validity of a central Kurdish version of the Dizziness handicap inventory. Sci Rep. 2019;9(1):8542. https://doi.org/10.1038/s41598-019-45033-1.

2. Zmnako SSF, Chalabi YI. Cross-cultural adaptation, reliability, and validity of the Vertigo symptom scale–short form in the central Kurdish dialect. Health Qual Life Outcomes. 2019;17(1):125. https://doi.org/10.1186/s12955-019-1168-z.

Glossary

AIC	Average Inter-item Correlations
AIID	Alpha (α) If Item Deleted
AUC	Area Under receiver operating characteristic Curve
AVE	Average Variance Extracted
BPPV	Benign Paroxysmal Positional Vertigo
C1	First Copy
C1/2	Merge of first and second copies
C2	Second copy
CCE	Cooksey and Cawthorne Exercise
CI-TC	Corrected Item-Total Correlation
COSMIN	COnsensus-based standards for the Selection of Health Status Measurement Instruments
CPV	Cumulative Proportions of Variance
CTSIB	Clinical Test of Sensory Interaction and Balance
CTSIB-S	Clinical Test of Sensory Interaction and Balance-Sum of conditions 3 and 6
CTSIB-T	Clinical Test of Sensory Interaction and Balance-Total
DHI	Dizziness Handicap Inventory
DHI-CK	Dizziness Handicap Inventory-Central Kurdish
DHI-E	Dizziness Handicap Inventory-Emotional

DHI-F	Dizziness Handicap Inventory-Functional
DHI-P	Dizziness Handicap Inventory-Physical
DHI-T	Dizziness Handicap Inventory-Total
DVD	Digital Video Disc
DWLS	Diagonally Weighted Least Squares
EFA	Exploratory Factor Analysis
FG	Focus Group
HPA	Horn's Parallel Analysis
HTMT	HeteroTrait-MonoTrait ratio of correlations
IBM	International Business Machines
ICC	Intraclass Correlation Coefficient
IFC	Inter-Factor Correlation
IFC^2	Square of Inter-Factor Correlation
M	Mean
MAP	Minimum Average Partial
MCP	Modified Cooksey ─ Cawthorne Exercise Protocol
MD	Meniere's Disease
MeSH	Medical Subject Headings
O_1	First Occasion
O_2	Second Occasion

OMs	Outcome Measures
PAF	Principal Axis Factoring
PC	Polychoric Correlations
PLS	Partial Least Squares
PROMs	Patient-Reported Outcome Measures
R_1	First Rater
R_2	Second Rater
rhoA	Consistent reliability of the partial least squares
rhoC	Composite reliability
RMSEA	Root Mean Square Error of Approximation
ROC	Receiver Operating Characteristic
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
T_1	First translation
T_2	Second translation
TR	Tandem Romberg
TR-T	Tandem Romberg-Total score
UPVD	Unilateral Peripheral Vestibular Disorders
UPVH	Unilateral Peripheral Vestibular Hypofunction
VAS	Visual Analogue Scale

VAS-T	Visual Analogue Scale-Total
VD	Vestibular disorders
VDM	Visual Dependency Measures
VM	Vestibular Migraine
VOP	Video Optokinetic-training Protocol
VOR	Vestibuleo-Ocular Reflex
VSS	Vertigo Symptom Scale
VSS-AA	Vertigo Symptom Scale-Autonomic-Anxiety
VSS-SF	Vertigo Symptom Scale-Short Form
VSS-SF-CK	Vertigo Symptom Scale-Short Form-Central Kurdish
VSS-T	Vertigo Symptom Scale-Total score
VSS-V	Vertigo Symptom Scale-Vestibular
VVAS	Visual Vertigo Analogue Scale
VVAT-T	Visual Vertigo Analogue Scale -Total
α	Cronbach's alpha

Chapter 1 Introduction

1.1 Introduction

Vestibular disorders are common among adult population[1, 2] implicating a major health and cost issues[3-5]; yet, require frequent visits to the health care centers[2]. Furthermore, their assessment is challenging[6], because symptoms produced by these disorders are subjective and imprecise[7]; that is, difficult for patient to report and require much effort from physician to understand and quantify[8]. Additionally, symptoms may present in various patterns; such as, acute, episodic, and chronic presentations and can be consequences of a wide range of mixed differential diagnosis, e.g., peripheral or central, unilateral or bilateral, and vestibular and non-vestibular origins[9]. Moreover, there is also lack of conspicuous and consistent formula to define vestibular symptoms and disorders[10].

Consequently, this inconspicuousness and inconsistency around the consequences of vestibular disorders has halted the scientific progress in the field. The Barany society has realized this fact and took the initial step by classifying the vestibular symptoms and providing specific definition for each of them[10]. Moreover, researchers and clinicians have found a potential way to overcome the problem of vestibular symptoms' quantification; that is, development and utilization of related patient-reported outcome measures (PROMs) through reliable and validated questionnaires, and this solution has increasingly gained reputation and assent in various fields of medicine including vestibular specialty[11].

Because of the anatomical and physiological nature of the vestibular system; that is, balance between the right and left peripheral sides of the system, majority of the

disorders arises from imbalances between the two sides (right-left asymmetry). As a result, unilateral peripheral vestibular disorders (UPVD) are the commonest disorders[12, 13]. Further, there are factors that delay the recovery of the symptomatic imbalance, thereby the condition enters the chronic stage. Among these factors, permanent deficit, insufficient central compensation, psychological issue, and halted vestibular adaptation because of overreliance on visual cues; that is, visual dependency[14].

Unfortunately, substantial number of patients with chronic UPVD are reluctant to classical treatments such as medications and surgery[15]. Fortunately, they respond well to different modalities of vestibular rehabilitation; accordingly, these modalities have gained acceptance and popularity[16].

Among these modalities of rehabilitation, repeated optokinetic stimulation is a potential approach that promote vestibular adaptation by strengthening the vestibulo-ocular reflex (VOR) gain. The process can be initiated through exposing the patient to visually conflicting environments[17]. thereby decreasing the retinal slip and enhancing the VOR gain. Consequently, it efficiently enhances vestibular adaptation and decreases visual dependency[18].

It would be a great help to the patients and health institutions, if home-environment used as a setting for rehabilitation protocols. Luckily, videos of daily activities that contain visually conflicted scenes could be used as home-based rehabilitation protocol for optokinetic-training[19]. Accordingly, a group of video clips, specifically produced for optokinetic-training, was created by Gabrielle Pierce, a doctor of physiotherapy. They contain complex moving patterns and videos of forward and reverse car driving in busy and visually conflicted places such as bridges and repeated pattern roads[20].

Concerning vestibular specialty, there are many validated PROMs; however, two of them have been extensively used as an outcome measures (OMs); that is, first,

Dizziness Handicap Inventory (DHI) that measure the physical, emotional, and functional impacts of vestibular disorders[21] and the second, Vertigo Symptom Scale (VSS) that measure the frequencies of vestibular symptoms and their concomitant autonomic-anxiety symptoms[22]. The two aforementioned PROMs have been cross-culturally validated (translation, cross-cultural adaptation, and validation) to different languages all-over the globe; accordingly, in the vestibular field, they were used as efficient outcome measures in pre and post treatment protocols[23-28].

The population of interest in this dissertation was derived from Kurds. They populate a wide area in the Middle East. There is a wide discrepancy in estimates of the total number of Kurds, which range broadly between 15 to 25 million. Kurdish is a member of the Indo-European family of languages, and is now official in Iraq; it consists of two main dialects: central Kurdish (Sorani) and northern Kurdish (Kurmanji)[29].

To the best of our knowledge, until now, there is no any cross-culturally validated PROMs in vestibular specialty that can be used by Kurdish medical community to quantify these demanding disorders; moreover, in this locality (Sulaimani governorate, Iraq) we could not find reported studies related to home based vestibular rehabilitation protocols.

Accordingly, in this dissertation, a randomized double-blinded controlled trial was implemented in Sulaimani governorate, to verify the effectiveness of video optokinetic-training protocol (VOP) in patients with chronic UPVD having visually induced vestibular symptoms (dizziness, vertigo, and unsteadiness when they exposed to visually conflicted environments). However, as a preliminary necessary step and to supply the work with validated Kurdish PROMs, the study has also cross-culturally validated both DHI and the short form of VSS into central Kurdish dialect; that is DHI-CK and VSS-SF-CK, respectively.

Chapter 2 Reliability and Validity of a Central Kurdish Version of the Dizziness Handicap Inventory

2.1 Abstract

2.1.1 Background

Vestibular disorders are common and are associated with major health and cost issues. their assessment is challenging, because their symptoms and consequences are imprecise, subjective, and difficult to study and quantify. The Dizziness Handicap Inventory (DHI) is a widely used patient-reported outcome measures (PROMs) in the vestibular field and it has been cross-culturally validated to many languages across the globe.

2.1.2 Objective

The objective of this study was to cross-culturally validate the Dizziness Handicap Inventory in to central Kurdish dialect (DHI−CK); that is, cross-cultural adaptation (translation and cultural adaptation) and verification of its reliability and validity.

2.1.3 **Methods**

A cross-sectional study was utilized to measure the impacts of vestibular disorders. Along with the DHI−CK, two comparators were introduced: The Visual Analogue Scale and the Clinical Test of Sensory Interaction and Balance. External and internal reliability were tested with intraclass correlation coefficient (ICC) and Cronbach's alpha/composite reliability, respectively.

2.1.4 **Results**

Patients (n = 301; mean age = 44.5 ± 15.2 years; 59.8% women) presenting with vestibular symptoms for at least 30 days who were diagnosed with a vestibular disorder and healthy participants (n = 43; mean age = 42 ± 17.9 years; 62.8% women) (N = 344). The DHI−CK and its three sub-scales—Physical, Emotional, Functional—exhibited good to excellent external reliability: ICCs in the test-retest were 0.93, 0.88, 0.91, and 0.92, respectively. Cronbach's alphas were 0.87, 0.71, 0.75, and 0.73, respectively. Convergent validity was supported by Spearman's correlations between the DHI−CK and the comparators. The Mann-Whitney U Test and the receiver operating characteristic curve analysis confirmed discriminating validity.

2.1.5 **Conclusion**

The DHI−CK was cross-culturally validated. It is a reliable and valid tool that can be used by clinicians and researchers to quantify vestibular disorder outcomes in Kurdish-speaking populations.

2.2 Introduction

Vestibular symptoms are common and are associated with major health and cost issues[5]. Patients with vestibular disorders require frequent visits to primary care centres[2]; furthermore, their assessment is challenging, and the symptoms and consequences produced by these disorders are imprecise, subjective, and difficult to study and quantify[7]. Objective findings such as caloric tests, laboratory results, and even radiological investigations are of limited value if they do not coincide with clinical findings[30]. Therefore, over the past few decades, researchers and clinicians presented a satisfactory solution to quantify the symptoms through development of suitable instruments: patient-reported outcome measures (PROMs), which are typically complete via self-administered questionnaires. PROMs are a quick, authentic way to measure the impacts of demanding disorders[11, 31].

However, for PROMs to be qualified, they must be reliable; otherwise, performing clinical research and/or practice with instruments of poor quality is unethical and a waste of resources[32]. The outcome data of any measurement-instrument are trustworthy only if that instrument has been academically subjected to reliability and validity testing[11].

Translation of a valid instrument to another language may dissipate its quality because of cultural differences among populations. Therefore, in addition to translation and cultural adaptation, reliability and validity must also be repeated and reported in harmony with the noted guidelines[33].

The Dizziness Handicap Inventory (DHI) (Appendix 1) was developed by Jacobson and Newman[21]. It is a widely used PROM in the vestibular field[34]. The 25-item tool comprises three sub-scales: physical (DHI–P; 7 items), emotional (DHI–E; 9 items), and functional (DHI–F; 9 items). For each item, the respondent must select one of three

responses, each assigned a specific value (*yes* = 4, *sometimes* = 2, and *no* = 0). The total sum of the scores in three sub-scales (DHI–T) range 0–100, with higher score indicating greater self-reported handicap.

The original English version of the DHI has been cross-culturally validated in many other languages, including several languages that are spoken in the Middle East: Hebrew[35], Arabic[36], Persian[37], and Turkish[38].

To our knowledge, there is no validated vestibular PROM in Kurdish; therefore, the study has cross-culturally adapted the DHI into Central Kurdish dialect (DHI–CK) and verified its reliability and validity.

2.3 Methods

2.3.1 Ethics

The present study commenced after obtaining approval (no. 43B) from the Ethical Committee of the College of Medicine, Sulaimani University, Iraq. This study was conducted in accordance with the 2008 Declaration of Helsinki. Participants who met the inclusion criteria were enrolled after providing informed, written consent.

2.3.2 Cross-cultural adaptation

Steps recommended in two related guidelines by Wild and colleagues and Beaton and colleagues were followed during this process[33, 39].

2.3.2.1 Initial stage

The initial stage comprised three steps:

2.3.2.1.1 Endorsement for cross-cultural adaptation to Kurdish was granted from professor Jacobson (Appendix 2), the original developer[21].

2.3.2.1.2 We ensured that translated questions were understandable. Words or expressions that are not familiar must be substituted by the most appropriate ones without losing their meaning.

2.3.2.1.3 We implemented necessary focus-group sessions (consisting of 7 otolaryngologists) according to specific guidelines; that is, Stalmeijer and colleagues and Wong[40, 41].

2.3.2.2 **Translation stage**

The DHI was translated from English to Central Kurdish twice: the first copy (C_1) by an expert otolaryngologist and the second (C_2) by a professional bilingual translator. Both were synthesized to form $C_1/_2$. During synthesis, vague words were clarified, and formal expressions were popularized (e.g. 'dancing' was changed to '*shayi*', which represents a traditional celebration; and the translated word for 'embarrassed' was replaced by a more popular Arabic word).

Then, the $C_1/_2$ was back-translated to English and compared with the original version—which revealed they were congruous—followed by minor editing for the pre-final copy. Next, a pilot study was conducted with 12 educated patients with good linguistic skills from the target population to clarify the questions. The content and face validity was assessed through a specifically designed rating scale (Appendix 3); through this scale, patients from the pilot test and members of the FG have rated each item. Furthermore, the face and content were excellently (91%) validated by the FG (Appendix 4). Eventually, after proofreading, the final version was created (Appendix 5), and the procedure was reported to the College of Medicine – University of Sulaimani (hereafter, "the institute").

2.3.3 **Design and Participants**

2.3.3.1 **Design of the study**

A cross-sectional survey was utilized to perform the study; however, for the reliability subgroup, the survey was converted to a short-term longitudinal.

2.3.3.2 Participants and enrolments

2.3.3.2.1 Setting: enrolment occurred in two well-resourced tertiary clinics that cover a considerable amount of the Sulaimani governorate in Iraq.

2.3.3.2.2 Participants: before inclusion participants' cognitive state was assessed through a general clinical examination; additionally, for older participants (aged > 65 years), the Mini-Mental State Examination was also utilised. Inclusion criteria were as follows: aged 18 to 79 years, having vestibular symptoms for at least 30 days, received an objective diagnosis of a vestibular disorder, and passing the cognitive assessment. Participants who could not answer or were unable to perform objective tests and those with associated non-vestibular pathology were excluded from analyses.

2.3.3.2.3 Duration subgroups: to assess the discriminating validity of the tool, based on the duration of vestibular symptoms, included patients were categorised into two subgroups: 1 (symptoms for 1–6 months) and 2 (symptoms for 7−180 months).

2.3.3.2.4 Reliability subgroup: patients in the reliability subgroup (n = 70), were rated on two occasions. The interval between occasions was 1 to 5 days for both PROMs; while, for the below mentioned objective test; that is, the clinical test of sensory interaction and balance (CTSIB) the interval was 1 to 2 hours (to avoid the effects of in-between rehabilitations and/or central adaptation). The time of the second rating was adjusted by the interviewers per patients' availability.

2.3.3.3 **Interviewers (raters)**

The DHI is a self-administered tool; therefore, the interviewer's role was minimal (19); however, because of the inclusion of illiterate participants, the survey involved two interviewers with proximate abilities. The job of the interviewers was to introduce the task, provide any necessary explanations, and/or read the items to participants who could not read.

2.3.3.4 **Sample size**

The sample size was determined based on the participant-to-variable ratio of at least 10 participants for each item[42]. Accordingly, it was estimated that 301 patients would be sufficient. From March 2017 to June 2018, patients were included in the study.

2.3.3.5 **Randomization process**

While patients were receiving the results of their tests or rehabilitation treatments, they were invited to participate. Those who consented and met the inclusion criteria were systematically numbered. The first patient was selected randomly followed by a constant interval selection.

2.3.3.6 **Measurement errors and recall bias**

Steps were taken to minimize measurement errors and recall bias such as changing the sequence of the questions, applying a similar setting, excluding unstable patients, and not interfering with the patients during response selection.

2.3.4 Comparator instruments

In addition to the DHI–CK, the following two other outcome measures were introduced:

2.3.4.1 Visual Analogue Scale (VAS)

The VAS has been widely used as an outcome measure. de Boer and colleagues[43] concluded that the VAS has good psychometric properties. Because of the lack of any validated PROMs in Kurdish that can measure the same construct, VAS was utilized as a comparator. A printed scale with one-hundred fractions from zero to 100 was used: in which, zero denotes no-handicap and 100 denotes maximum-handicap (Appendixes 6 and 7). Patients were asked to score his/her overall resultant handicap (VAS–T) since vestibular symptom onset.

2.3.4.2 CTSIB

Participants were asked to maintain balance for three trials in six conditions. They were standing with both legs and feet close together, wearing socks, and looking forward with each palm over the corresponding shoulder. The six conditions were as follows: 1) stable and flat surface with eyes open, 2) stable and flat surface with eyes-closed, 3) stable and flat surface with eyes-open and wearing a visual-conflict dome, 4) compliant spongy surface with eyes open, 5) compliant spongy surface with eyes closed, and 6) compliant spongy surface with eyes open and wearing a visual-conflict dome (Appendixes 8 and 9). Any trial was completed if the participant could or could not maintain his/her balance for 1 minute, moving palm or foot, loss of balance, seeking assistance, or opening eyes in the eyes-closed condition. Second and/or third trials were only needed if the participant could not complete the 1 minute in the preceding trial. For each condition, the sum was calculated by dividing the total seconds for available trial/s on number of trial/s for that condition, while the total score (CTSIB–T) was the total of all six conditions[44].

2.3.5 **Hypotheses**

DHI–CK and the designed VAS for this study are subjective scores; they are cumulative measures for the same construct; i.e. the overall handicap induced by vestibular disorders from the onset of symptoms to the time of rating. However, CTSIB–T is an objective score that measures the steadiness at a specific time; i.e. the time of testing[22]. Appropriately, to assess the concept and the discriminating ability of the instrument on the base of the duration (elapsed time from the beginning of the symptoms to the time of rating), patients were categorized into two subgroups and devised the following hypotheses:

2.3.5.1 **Convergent validity**

2.3.5.1.1 In all patients, the positive correlation between the DHI–T and VAS–T would be adequate;

2.3.5.1.2 In all patients, the negative correlation between CTSIB–T with both DHI–P and DHI–F would be moderate because they are measuring the steadiness in two distinct ways (objective and subjective).

2.3.5.2 **Discriminating validity**

2.3.5.2.1 The distribution of the four DHI scores (three sub-scales and total) would be the same across patients' subgroups because the scores are a cumulative measure and are not related to the amount of time elapsed; however, it would differ between the all patients/subgroups and the healthy group because the tool was originally designed to measure the impacts of vestibular disorders.

2.3.6 Statistical analyses

2.3.6.1 Data screening

Records with missing values were pair-wise excluded. Ceiling and floor effects were absent in the three outcome measures. Considering our sample size, an absolute value for standardised Z-score greater than 3.29[45] and absolute values greater than 2 and 7 for skewness and kurtosis[46] respectively, were considered as non-normal; moreover, a chi-square critical value of < 0.001 in Mahalanobis distance was considered a multivariate outlier[47].

The scores of 24 questions and the four scales were distributed normally, as none of them exceeded these cut-off points. However, the normality was violated by Item-E15, in which, absolute skewness and kurtosis were 3.32 and 9.7, respectively (Table 4), and Z-scores of each of the 16 cases were 3.88 (> 3.29); therefore, they were considered as a potential univariate outlier. Necessarily, using IBM SPSS macro from DeCarlo[48] the multivariate distribution for all 25-items were tested, which revealed asymmetry and significant *p*-values for both skewness and kurtosis (Mardia's test). Non-normality is expected in ordinal data such as Likert-items[49]; consequently, the study followed Feng et al.[50] and utilized non-parametric tests instead of log-transformation.

2.3.6.2 External reliability

Because of the involvement of two specific interviewers, the choice of the model, type, and the definition of intraclass correlation coefficient (ICC) were two-way mixed-effect, mean of *k* interviewers, and absolute agreement, respectively. Referenced values of < 0.5, from 0.5 to 0.75, from 0.75 to 0.90, and > 0.90 indicate poor, moderate, good, and excellent reliability, respectively[51].

2.3.6.3 **Internal consistency**

For examination of the internal consistency of the instrument, the following six variables and their corresponding referenced values were used and followed, respectively:

2.3.6.3.1 Cronbach's alpha (α), > 0.7[52].

2.3.6.3.2 Average inter-item correlations (AIC), from 0.2 to 0.5 [53].

2.3.6.3.3 The corrected item-total correlations (CI–TC), > 0.2[54].

2.3.6.3.4 α if item deleted (AIID), when any item deleted, α of the corresponding scale should not inflate[52].

2.3.6.3.5 Composite reliability (rhoC), > 0.7.

2.3.6.3.6 Reliability of the partial least squares (rhoA), > 0.7[55].

2.3.6.4 **Convergent validity**

The associations between DHI–CK and the comparators were examined via Spearman's robust rank correlation[49, 56]. Referenced values for the associations were < 0.3, > 0.3 < 0.5, > 0.5 < 0.7, and > 0.7 for weak, moderate, adequate, and high correlations, respectively[57, 58].

2.3.6.5 **Discriminating validity**

The ability of the four scales to discriminate between different groups and subgroups; that is, patient/healthy groups and the patients' subgroups were examined by employing the following two methods:

2.3.6.5.1 The receiver operating characteristic (ROC) curve. Concerning the areas under the ROC curve (AUC), the study followed Hosmer and colleagues[59], with referenced values as follows: AUC = 0.5, 0.5 < AUC < 0.7, 0.7 ≤ AUC < 0.8, 0.8 ≤ AUC < 0.9, and AUC > 0.9 suggested no, poor, acceptable, excellent, and outstanding discrimination, respectively. The Youden indices and their associated criterion values for the scales were estimated.

2.3.6.5.2 With a significance level of 5%, the survey utilised the Mann-Whitney U test to examine discriminating validity. Since the shape and the distribution of the scales between the patient and the healthy groups were dissimilar, the analysis compared mean ranks instead of medians; however, for patients' subgroups, medians were compared, because the shapes were similar[56].

2.3.6.6 **Software**

For all steps of the analysis SPSS 21 (IBM, Armonk, NY, USA) was used, except for rhoC and rhoA, which were determined by SmartPLS 3[60]. Data related to the ROC curve analysis (Table 7) were obtained from MedCalc for Windows, version 19.0.3 (MedCalc Software, Ostend, Belgium).

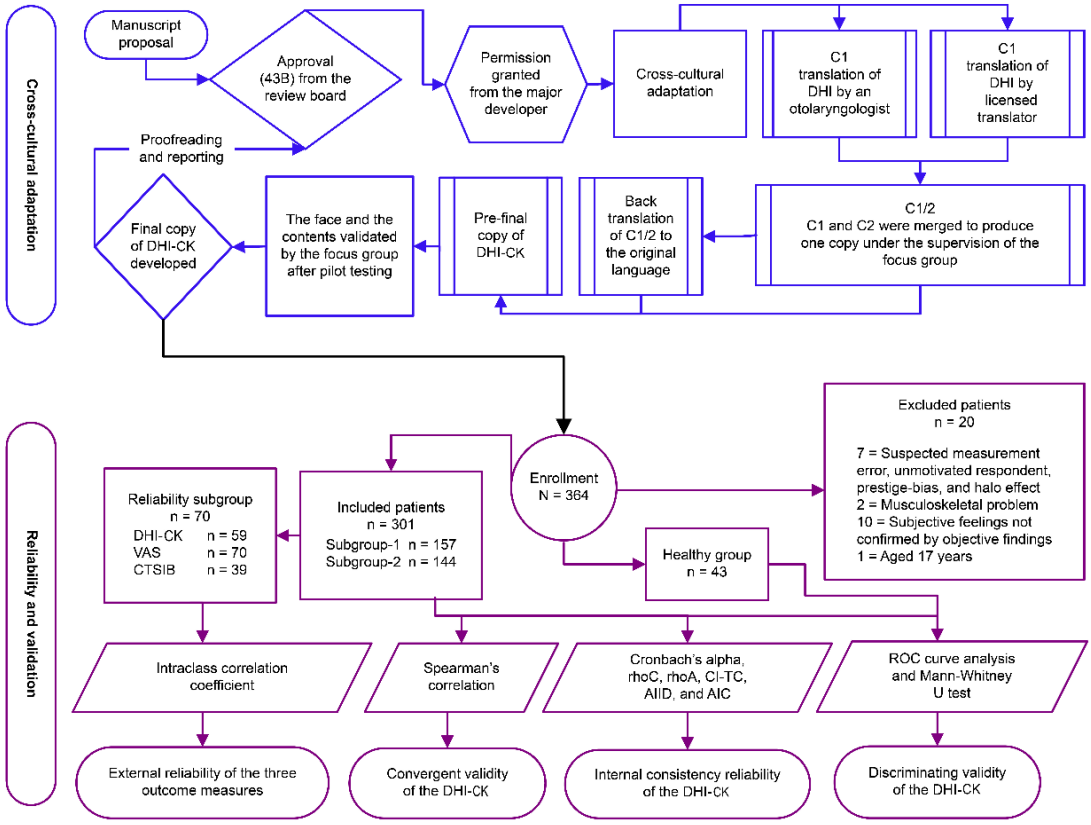

Figure 2.1 The logic sequence of the study

Abbreviations: C1, first translated copy; C2, second translated copy; C1/2, merge of C1 and C2; DHI–CK, Dizziness Handicap Inventory–Central Kurdish; VAS, Visual Analogue Scale; CTSIB, Clinical Test of Sensory Interaction and Balance; rhoC, composite reliability; rhoA, consistent reliability of the partial least squares; CI–TC, corrected item-total correlation; AIC, average inter-item correlation; AIID, alpha if item deleted; ROC, receiver operating characteristic.

2.4 Results

2.4.1 The logic sequence of the study

The flowchart in **Figure 2.1** demonstrates the steps of cross-cultural adaptation, enrolments, and the statistical approaches for assessment of psychometric properties of the DHI–CK. Among the 321 patients, 20 were excluded; however, the exclusions did not result in significant differences in the analyses.

2.4.2 Participants' baseline characteristics

Participants' baseline characteristics are shown in **Table 2.1**. Patients' (n = 301; 59.8% women) mean age was 44.5 ± 15.2 years (range = 61 years). Healthy participants' (n = 43; 62.8% women) mean age was 42 ± 17.9 years (range = 57 years). The percentage of patients in the three age ranges was as follows: n = 49, 16.3% (18–29 years); n = 187, 62.1% (30–59 years); and n = 65, 21.6% (60–79 years). Patients with no or only a primary education (n = 163; 54.2%) were assisted by an interviewer with survey completion. More than half of the patients (n = 157; 52.2%) had vestibular symptoms within the range of 1–6 months. The unilateral peripheral vestibular hypo-function was the commonest disorder (35.9%).

Table 2.1 Participants' baseline characteristics (N = 344).

	Patients		Reliability subgroup		Duration subgroups[a]				Healthy group	
					Subgroup−1		Subgroup−2			
	n = 301		n = 70		n = 157		n = 144		n = 43	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Age (years)	44.5	15.2	45.8	16.5	43.4	15.5	45.7	14.8	42	17.9
Duration[a]	17.3	28.8	12.6	27.3	2.4	1.6	33.8	35		
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Women	180	59.8	34	48.6	89	56.7	91	63.2	27	62.8
Education										
No or Primary[bc]	163	54.2	42	60	86	54.8	77	53.5	22	51.2
Secondary[bd]	87	28.9	15	21.4	43	27.4	44	30.6	14	32.6
Higher education[de]	51	16.9	13	18.6	28	17.8	23	16	7	16.3
Diagnosis										
BPPV	41	13.6	7	10	23	14.6	18	12.5		
MD	24	8	10	14.3	8	5.1	16	11.1		
UPVH	108	35.9	27	38.6	64	40.8	44	30.6		
VM	26	8.6	3	4.3	15	9.6	11	7.6		
Other VD[f]	102	33.9	23	32.9	47	29.9	55	38.2		

Note: [a]Subgroups categorised based on duration of vestibular symptoms in months: 1−6 and 7−180 months for subgroups 1 and 2, respectively; [b]Schools; [c]DHI-CK administered by an interviewer; [d]DHI-CK administered by the patient; [e]Education higher than secondary school, that is, diploma, bachelor, and postgraduate educations; [f]Distinct diagnoses could not be recognised.
Abbreviations: M, Mean; SD, Standard deviation; BPPV, Benign paroxysmal positional vertigo; MD, Meniere's disease; UPVH, Unilateral peripheral vestibular hypofunction; VM, Vestibular migraine; VD, Vestibular disorders; DHI-CK, Dizziness Handicap Inventory-Central Kurdish.

2.4.3 **External reliability**

The four scales of the instrument revealed good to excellent external reliability; the ICC of the test-retest reliability for DHI–P, DHI–E, DHI–F, and DHI–T were 0.88, 0.91, 0.92, and 0.93 respectively. The total scores of both comparators—CTSIB–T and VAS–T—also exhibited excellent reliability: 0.91 and 0.95, respectively (**Table 2.2**).

Table 2.2 External reliability of the three outcome measures.

	n = 59								n = 39		n = 70	
	DHI–P		DHI–E		DHI–F		DHI–T		CTSIB–T		VAS–T	
	ICC[a]	n	ICC[a]	n	ICC[a]	n	ICC[a]	n	ICC[a]	N	ICC[a]	n
Test-retest	0.88	59	0.91	59	0.92	59	0.93	59	0.91	39	0.95	70
Inter-interviewer	0.95	24	0.90	24	0.95	24	0.97	24	0.93	16	0.95	29
Intra-interviewer1	0.81	16	0.88	16	0.91	16	0.90	16	0.95	12	0.92	18
Intra-interviewer2	0.82	19	0.94	19	0.89	19	0.90	19	0.76	11	0.97	23

Note: [a]Intraclass correlation: two-way mixed effects, mean of k interviewers, and absolute agreement for the model, type, and the definition, respectively.
Abbreviations: DHI–P/E/F/T, Dizziness Handicap Inventory–Physical/Emotional/Functional/Total, respectively; CTSIB–T, Clinical Test of Sensory Interaction and Balance–Total; VAS–T, Visual Analogue Scale–Total; ICC, Intraclass correlation coefficient.

2.4.4 **Internal consistency reliability**

αs of the DHI–P, DHI–E, DHI–F, and DHI–T were 0.71, 0.75, 0.73, and 0.87, respectively. The AIC of all scales were satisfactory as they were located within the acceptable range of 0.2–0.5. The CI–TC of the 25 items in all scales showed acceptable values; nearly all the 25 items in the DHI–T acquired values above 0.3 (item-F7 was 0.29). Both rhoC and rhoA in the three sub-scales were > 0.7 (**Table 2.3**). The AIID; was estimated; that is, the resulting αs of the sub-scales and the total scale when any item was deleted, no inflation was noticed in these αs.

In non-normal item-E15, the frequency of the 301 responses was as follows: yes = 16, sometimes = 11, and no = 274. The standardized values of each of the records were < 3.29 except for those of yes-response records (3.88). The possible negative effects of this non-normality were investigated by analyzing data with and without the item; however, almost all internal consistency parameters remained the same (**Table 2.4**).

Table 2.3 Internal consistency variables of Kurdish, Original, and German versions.

	DHI–CK				**Original[a]**	**German[b]**
	n = 301				n = 106	n = 127
	Corrected item-total correlation					
	DHI–P	DHI–E	DHI–F	DHI–T	DHI–T	DHI–T
P1- Looking up	0.48			0.31	0.54	0.32
E2- Being frustrated		0.41		0.42	0.34	0.51
F3- Restricting travel			0.54	0.51	0.76	0.61
P4- Walk via supermarket aisle	0.35			0.44	0.39	0.48
F5- Getting out or into bed			0.22	0.33	0.50	0.41
F6- Restricting social activities			0.52	0.53	0.69	0.72
F7- Reading difficulties			0.24	0.29	0.44	0.36
P8- Sports-like activities	0.38			0.52	0.54	0.67
E9- Afraid to leave home alone		0.47		0.50	0.43	0.49
E10- Embarrassment		0.40		0.46	0.46	0.27
P11- Quick head movement	0.58			0.47	0.51	0.41
F12- Avoid heights			0.22	0.32	0.49	0.42
P13- Turning over in bed	0.38			0.34	0.43	0.27
F14- Heavy housework			0.51	0.54	0.58	0.69
E15- Considered intoxicated		0.28		0.33	0.30	0.48
F16- Difficult to go for a walk			0.50	0.61	0.62	0.57
P17- Sidewalk walking	0.28			0.41	0.58	0.46
E18- Concentration difficulties		0.27		0.33	0.49	0.51
F19- Walking in the dark			0.28	0.35	0.48	0.32
E20- Fear of being alone		0.45		0.48	0.27	0.37
E21- Feeling handicapped		0.57		0.45	0.41	0.71
E22- Stress on relationships		0.50		0.49	0.46	0.60
E23- Being depressed		0.54		0.39	0.41	0.63
F24- Responsibility issues			0.58	0.63	0.56	0.66
P25- Bending over	0.50			0.46	0.57	0.32
Cronbach's alpha	**0.71**	**0.75**	**0.73**	**0.87**		
AIC	0.26	0.25	0.22	0.22		
RhoC	0.80	0.82	0.80			
RhoA	0.71	0.76	0.77			

Note: For simplicity, items reduced; Alphas of the scales are in bold; [a]Jacobson, G. P. & Newman, C. W. The development of the dizziness handicap inventory. *Arch. Otolaryngol. Head Neck Surg* 116, 424−427; 10.1001/archotol.1990.01870040046011 (1990); Kurre, A. *et al.* Translation, cross-cultural adaptation and reliability of the German version of the dizziness handicap inventory. *Otol. Neurotol.* 30, 359−367; 10.1097/MAO.0b013e3181977e09 (2009).
Abbreviations: DHI–CK/P/E/F/T, Dizziness Handicap Inventory–Central Kurdish/Physical/Emotional/Functional/Total, respectively; AIC, average inter-item correlation; rhoC, composite reliability; rhoA, consistent reliability of the partial least squares.

Table 2.4 Skewness, kurtosis, and internal consistency variables with and without item–E15.

	DHI–CK (n = 301)							
	Skewness[a]	Kurtosis[a]	Alpha if item deleted				*AIID*	*CI–TC*
			DHI–P	DHI–E	DHI–F	DHI–T	*DHI–T*	*DHI–T*
P1- Looking up	0.04	-1.60	0.661			0.872	*0.870*	*0.32*
E2- Being frustrated	-1.98	3.00		0.736		0.870	*0.868*	*0.42*
F3- Restricting travel	0.25	-1.73			0.674	0.866	*0.865*	*0.51*
P4- Walk via supermarket aisle	1.03	-0.68	0.693			0.869	*0.867*	*0.43*
F5- Getting out or into bed	-0.26	-1.22			0.729	0.872	*0.870*	*0.33*
F6- Restricting social activities	0.14	-1.70			0.678	0.866	*0.864*	*0.53*
F7- Reading difficulties	0.70	-1.25			0.728	0.873	*0.871*	*0.29*
P8- Sports-like activities	0.48	-1.51	0.686			0.866	*0.864*	*0.52*
E9- Afraid to leave home alone	0.57	-1.55		0.724		0.867	*0.865*	*0.50*
E10- Embarrassment	1.96	2.17		0.735		0.868	*0.867*	*0.45*
P11- Quick head movement	-0.39	-1.50	0.635			0.868	*0.866*	*0.47*
F12- Avoid heights	-0.25	-1.78			0.734	0.873	*0.871*	*0.32*
P13- Turning over in bed	0.17	-1.65	0.688			0.872	*0.870*	*0.34*
F14- heavy housework	-0.12	-1.89			0.679	0.865	*0.863*	*0.54*
E15- considered intoxicated	3.31	9.65		0.750		0.872		
F16- Difficult to go for a walk	0.74	-1.26			0.682	0.864	*0.862*	*0.60*
P17- Sidewalk walking	0.44	-1.36	0.710			0.870	*0.868*	*0.40*
E18- Concentration difficulties	-0.05	-1.64		0.758		0.872	*0.870*	*0.34*
F19- Walking in the dark	1.45	0.42			0.719	0.871	*0.869*	*0.35*
E20- Fear of being alone	1.36	-0.26		0.726		0.867	*0.865*	*0.48*
E21- Feelings handicapped	0.16	-1.75		0.704		0.868	*0.866*	*0.45*
E22- Stress on relationships	0.71	-0.96		0.717		0.867	*0.866*	*0.48*
E23- Being depressed	-0.74	-1.15		0.710		0.870	*0.868*	*0.39*
F24- Responsibilities issue	0.38	-1.44			0.669	0.863	*0.861*	*0.63*
P25- Bending over	-0.42	-1.30	0.657			0.868	*0.866*	*0.46*
Cronbach's alpha			0.709	0.752	0.725	0.873		
Values when item–E15 deleted								
Cronbach's alpha				*0.751*			*0.872*	
AIC				*0.27*			*0.22*	
RhoC				*0.82*				
RhoA				*0.76*				

Notes: For simplicity items shortened; [a]Absolute values of skewness and kurtosis; Alphas are of three decimal places to be compared with Alpha when any item deleted; Alphas of the scales are in bold; Values in italic were generated when item-E15 deleted.

Abbrevitions: DHI–CK/P/E/F/T, Dizziness Handicap Inventory–Central Kurdish/Physical/Emotional/Functional/Total; AIID, Alpha If Item Deleted; CI–TC, Corrected Item–Total Correlation; AIC, Average Inter-item Correlation; rhoC, Composite reliability; rhoA, Consistent reliability of the partial least squares.

2.4.5 **Convergent validity**

Spearman's correlation between DHI–T and VAS–T was 0.64; correlations of CTSIB–T with DHI–P and DHI–F were -0.31 and -0.38, respectively (Table 2.5); similar results were provided by Pearson's correlations (Table 2.6).

Table 2.5 Spearman's correlations between the scales and the comparators.

	n = 301			n = 290	n = 286
	DHI–P	**DHI–E**	**DHI–F**	**VAS–T**	**CTSIB–T**
DHI–P				0.46	**-0.31**
DHI–E	0.41			0.57	-0.30
DHI–F	0.67	0.69		0.58	**-0.38**
DHI–T	0.79	0.82	0.93	**0.64**	-0.39

Note: Correlations mentioned in the hypotheses are in bold.
Abbreviations: DHI–P/E/F/T, Dizziness Handicap Inventory–Physical/Emotional/Functional/Total, respectively; VAS–T, Visual Analogue Scale–Total; CTSIB–T, Clinical Test of Sensory Interaction and Balance–Total.

Table 2.6 Pearson's correlations between the scales and the comparators.

	n = 301			**n = 290**	**n = 286**
	DHI–P	DHI–E	DHI–F	VAS–T	CTSIB–T
DHI–P				0.44	-0.30
DHI–E	0.43			0.56	-0.33
DHI–F	0.68	0.70		0.56	-0.38
DHI–T	0.81	0.84	0.93	0.61	-0.40

Note: Correlations mentioned in the hypotheses are in bold.
Abbreviations: DHI–P/E/F/T, Dizziness Handicap Inventory–Physical/Emotional/Functional/Total; VAS–T, Visual Analogue Scale–Total; CTSIB–T, Clinical Test of Sensory Interaction and Balance–Total.

2.4.6 **Discriminating validity**

In patient/healthy groups, the AUC of the scores DHI–P, DHI–E, DHI–F, and DHI–T were 0.94, 0.98, 0.93, and 0.98 respectively; however, in patients' subgroups were 0.54, 0.54, 0.55, and 0.55 respectively (**Table 2.7** and **Fig. 2.2**). Moreover, the Mann-Whitney U test retained the null hypothesis when the scores of patients' subgroups were compared with each other (*ps* > .05); however, it was rejected when the scores of all patients and their subgroups were compared with those of the healthy group (*ps* < .05) and distinct distributions and shapes in all sub-scales and the total scale were revealed (**Figure 2.3**).

Table 2.7 The ability of the scales to discriminate between different groups and subgroups using receiver operating characteristic curve.

	Patient group (n = 301) Healthy group (n = 43)					Patients' subgroup-1[ab] (n = 157) Patients' subgroup-2[ab] (n = 144)				
	AUC	Youden index	Criterion value	Sensitivity	Specificity	AUC	Youden index	Criterion value	Sensitivity	Specificity
DHI-P	0.94	0.76	>2	92.36	83.72	0.54	0.09	>16	35.03	74.31
DHI-E	0.98	0.91	>2	96.01	95.35	0.54	0.10	>10	67.52	42.36
DHI-F	0.93	0.75	>6	81.73	93.02	0.55	0.09	>8	76.43	32.64
DHI-T	0.98	0.84	>10	96.01	88.37	0.55	0.10	>58	26.75	83.33

Note: [a]Subgroups categorised based on duration of vestibular symptoms in months: 1−6 and 7−180 months for subgroups 1 and 2, respectively; [b]Subgroup-1 and subgroup-2 defined as case and control, respectively.

Abbreviations: AUC, area under the receiver operating characteristic curve; DHI-P/E/F/T, Dizziness Handicap Inventory-Physical/Emotional/Functional/Total, respectively.

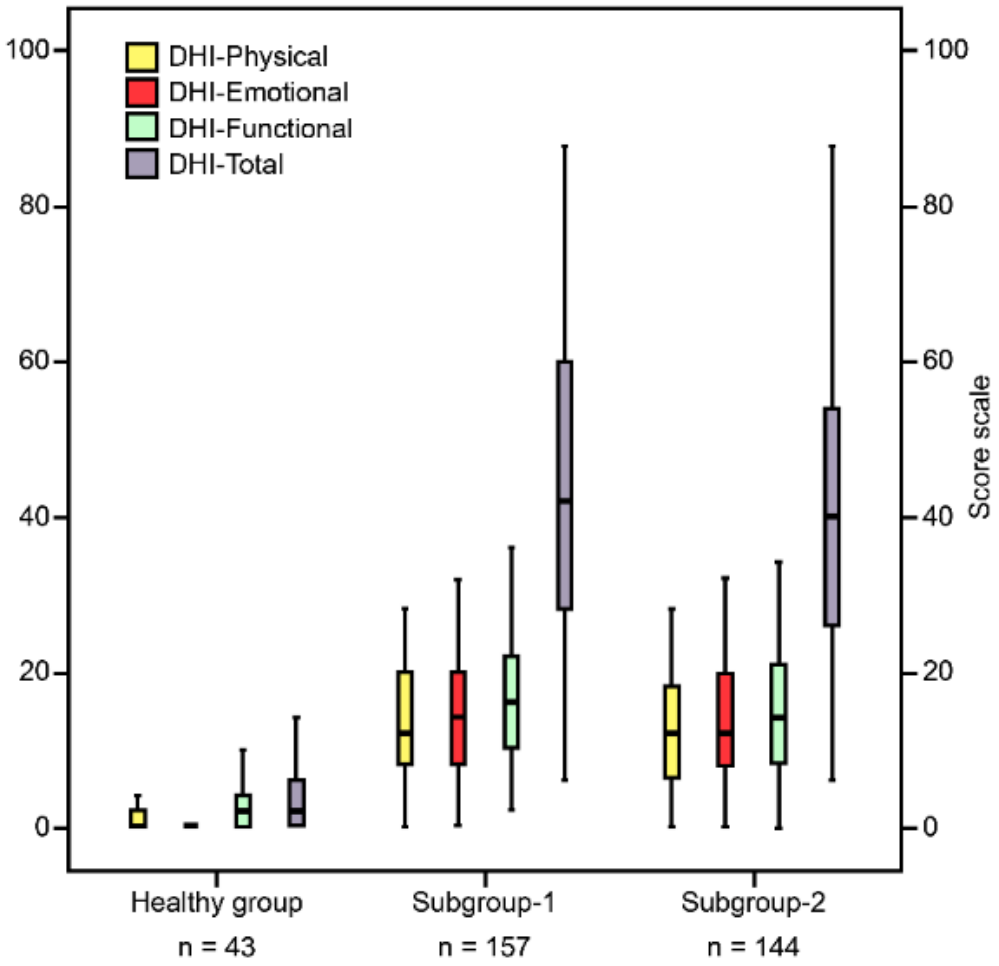

Figure 2.2 Shape and distribution of the scales in healthy and patients' subgroups

Note: Subgroups categorized based on duration of vestibular symptoms in months: 1−6 and 7−180 months for subgroups 1 and 2, respectively.
Abbreviation: DHI, Dizziness Handicap Inventory.

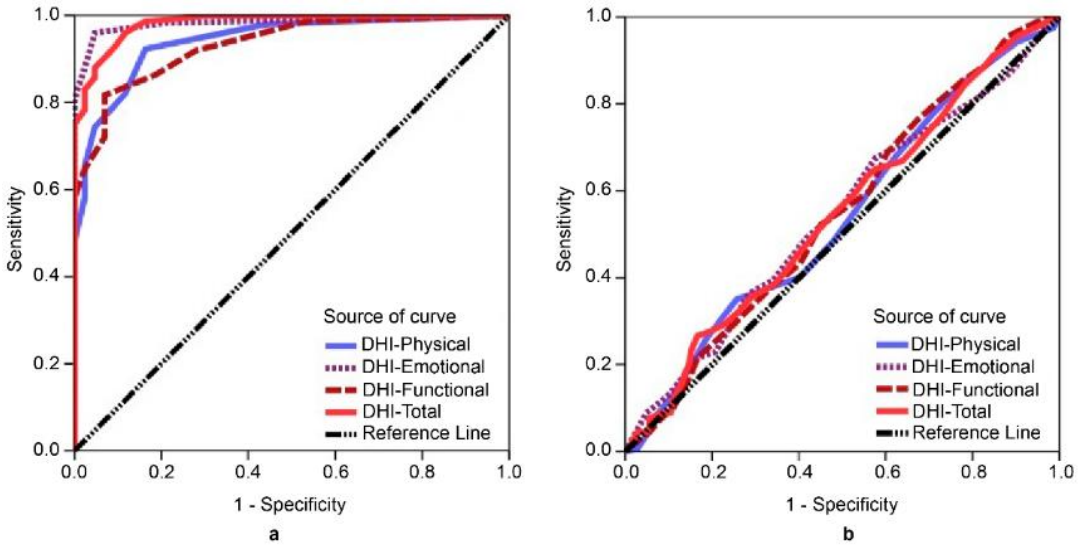

Figure 2.3 Comparison of receiver operating characteristic curves in different groups and subgroups. (a) Patient (n = 301)/heathy group (n = 43); (b) subgroup-1 (n = 157)/subgroup-2 (n = 144)

Note: Subgroups categorized based on duration of vestibular symptoms in months: 1−6 and 7−180 months for subgroups 1 and 2, respectively.

Abbreviation: DHI, Dizziness Handicap Inventory

2.5 Discussion

Validated PROMs are of utmost importance when examining vestibular disorder; unfortunately, to date, there has been no such instrument in Kurdish that can quantify the impact of vestibular disorders. Accordingly, using a focus group and key recommendations, we cross-culturally adapted the DHI into Central Kurdish.

Convincing a patient to participate in the target population was not difficult—meticulous explanation of the potential benefits of this study by the authors and the interviewers (raters) likely increased the participation rate. However, maintaining participants' motivation was challenging. We occasionally noticed that, after a few responses, participants' interest declined, which was resolved by changing from self-administered to interviewer-administered. Hence, employing interviewers was essential. Interviewers were instructed to delineate bias scores in cases of unreliable respondents, prestige-bias (where the patient reports what s/he wants instead of what s/he feels), and halo-effects (where the patient overgeneralizes the responses in either a positive or negative direction)[61]

Dizziness is a broad term, and it might be of non-vestibular origin[62]; however, the DHI was originally developed to evaluate the consequences of vestibular disorders. Therefore, to ensure sample representativeness, only cases with vestibular origin were included. Additionally, patients were of various ages from diverse settings.

The DHI–CK and its three sub-scales showed good to excellent external reliability. The present study almost replicated the test-retest reliability of the original scale[21], and other translated versions[23, 37, 63, 64]. Further, the internal consistency was broadly examined through most of the recommended criteria, and the DHI–CK and its three sub-scales had acceptable to good reliability. The CI–TC values for each item in the DHI–CK were compared with that of the original and German version[64], which also

revealed internal consistency (**Table 2.3**). However, our cut-off point of 0.2 for the CI–TC (the same used for the German version) varied from those reported (e.g. 0.3, 0.4, and 0.5) by other guidelines[54, 65]. If we consider this discrepancy and recall that the DHI was originally developed based on the CI–TC, one could argue about the structure of this popular PROM. In other words, factor analysis is superior to CI–TC when examining the structural organization of sub-scales. This was tested by both Kurre and colleagues[66] and Tamber and colleagues[63]; when they subjected DHI to a structural analysis, structures that differed from those of the original were found.

The non-normal E15 item (i.e. 'are you afraid people may think you are intoxicated?') and its effects on the analysis were thoroughly investigated. Concerning bias, a score related to alcohol consumption in a semi-conservative population (Kurdish) is a matter of debate. The possibility of prestige-bias in *no*-response records was considered, because this response is socially acceptable; likely the *yes*-response (potential outliers) provided legitimate data. Accordingly, it would be illogical to remove genuine data; further, deletion of these outliers makes the sample less representative. Consequently, to examine the effect of these aberrant 16 cases, instead of deletion, the data with and without item-E15 were analyzed separately. It was planned to permanently remove the item from the DHI–CK if there was substantial variation between the two analyses; however, no significant differences were found; therefore, the item was retained.

Our hypotheses regarding convergent validity were supported; an adequate positive correlation was found between the DHI–T and VAS–T, and a similar association was seen in the German version[64]. Furthermore, the negative and moderate range of correlations between the related sub-scales (DHI–P and DHI–F) and the objective score (CTSIB–T) in this study were similarly generated by both Kurre and colleagues[64] and Nikitas and colleagues[24], by correlating distinct types of objective scores with the DHI sub-scales.

This study revealed that the duration of the symptoms did not significantly affect the DHI scores; the instrument could not discriminate subgroups with different elapsed time for symptoms, confirming that the scores are collective measures. However, the ROC curve analysis and default Mann-Whitney U test confirmed that the instrument can effectively discriminate between healthy individuals and patients with vestibular disorders.

2.5.1 Strength and limitations

This study had some limitations. First, there were no validated PROMs for vestibular specialty in Kurdish to be used as a comparator in this study. Second, the C_{12} was back-translated only once. Lastly, the least time interval in reliability tests was reduced to one day because of patients' housing situation. It was noticed that long intervals are not suitable for reproducibility in patients with vestibular disorders because symptoms can change dramatically under the effect of central compensation; therefore, to avoid recall bias, it is better to use other measures, such as those that mentioned in the Methods section.

Despite these limitations, we believe that this work provides an essential tool that can be used by clinicians and researchers when examining Kurdish-speaking populations with such demanding disorders; moreover, this tool can be used as a cornerstone and a comparator when validating other similar PROMs in the future.

2.6 Conclusion and recommendation

The Kurdish medical community was deprived from any validated PROM in the field of vestibular disorders. Consequently, cross-cultural adaption of the DHI–CK and verification of its external and internal reliability were carried out. It was also established that it had acceptable convergent and discriminating validity. As an effective PROM, the DHI–CK can be utilized by clinicians and researchers to quantify the impacts of vestibular disorders in pre and post-therapeutic interventions. Further research should assess its internal dimensions, responsiveness, and interpretability.

2.7 Data Availability

The author confirms that the data supporting the findings of this study are available within the downloadable supplementary materials of a published article related to this dissertation[67].

Chapter 3 Cross-Cultural Adaptation, Reliability, and Validity of the Vertigo Symptom Scale–Short Form in the Kurdish Central dialect

3.1 Abstract

3.1.1 Background

Core vestibular symptoms are vague, hard for patients to describe, and difficult for examiners to quantify. Reliable and validated patient-reported outcome measures (PROMs) have obtained acceptance and popularity in the specialty of vestibular disorders. In Kurdish, there is a critical shortage of such measures. The aim of this survey was to assess the psychometric properties of a central Kurdish version (VSS−SF−KC) of the Vertigo Symptom Scale−Short Form (VSS−SF).

3.1.2 Methods

The study utilized a regulated process of cross-cultural adaptation to produce the VSS−SF−KC. The study examined its psychometric properties by using a cross-sectional survey. Owing to a non-normal distribution, both principal axis factoring and polychoric correlation were used to examine the structure. The internal consistency of the scales was evaluated using Cronbach's alpha coefficient (α) and composite reliability. The discriminant validity was evaluated using the heterotrait–monotrait ratio

of correlations (HTMT.85) and the Fornell-Larcker criterion. To assess convergent validity, the instrument was correlated with two comparators.

3.1.3 Results

The participants (n = 195) were composed of 165 patients with vestibular symptoms (mean−age 45 ± 15.8, range 61 years; 56.4% women) and 30 healthy participants (mean−age 35 ± 18.6; range 52 years; 60% women). Based on the scree plot, along with other criteria such as Horn's parallel analysis and minimum average partial, two factors were extracted: vestibular (VSS−V) and autonomic-anxiety (VSS−AA). Both constructs showed a robust structure in terms of adequate loadings and weak cross-loadings. The scales' αs were 0.81, 0.81, and 0.87 for VSS-V, VSS-AA, and the total scale (VSS−T), respectively. Discriminant validity was established with a value of 0.71 for HTMT (<0.85). Spearman's correlation supported the study's hypotheses and confirmed the convergent validity. Intraclass correlation coefficients revealed high external reliability: test-retest results were 0.93, 0.94, and 0.97 for VSS-V, VSS−AA, and VSS−T, respectively.

3.1.4 Conclusion

Given a critical shortage in PROMs for the vestibular field, the psychometric properties of VSS−SF−KC were evaluated. The results were promising, as they revealed external consistency and construct validity. The goodness of fit indices showed that the VSS−SF−KC is a reliable and validated PROM that can be used by clinicians and researchers in the Kurdish-speaking population.

3.2 Introduction

Vestibular disorders produce a group of vestibular symptoms as well as a range of concomitant autonomic-anxiety symptoms[10]. Epidemiological data on vestibular disorders in the general population are scarce. Studies have reported a discrepant range (6.1% to 27%) for one-year prevalence of vestibular symptoms[68]. However, they are prevalent among individuals visiting outpatient care centers[69]. Vestibular symptoms are vague and present themselves in different patterns (acute, episodic, and chronic)[9]. That is, they are difficult for patients to describe, and hard for healthcare professionals to evaluate[7]; hence, they place a burden on both patients and community[70].

One potential way to overcome the difficulty of evaluating demanding symptoms is the utilization of patient-reported outcome measures (PROMs) through reliable and validated questionnaires, which has gained acceptance and popularity in different fields of medicine[11]. Based on the Consensus-based Standards for the Selection of Health Status Measurement Instruments (COSMIN) checklist of property measurements[71], the clinical utility of a group of PROMs related to vestibular disorders was appraised through a systematic review; among them, the long form of the Vertigo-Symptom Scale earned the second highest score[72]. It was developed by Yardley et al.[22] and contains 34 items. However, Mendel et al.[73] found that utilizing the long form as a single aggregated scale may result in methodological bias; to overcome this hazard he suggested studying these items separately by using the short form (VSS−SF).

The VSS−SF (Appendix 10) is composed of 15 items[74], extracted from the long form. This self-rated questionnaire uses five-point scales ranging from 0–4, with response options of never, a few times, several times, quite often, and very often. The score indicates the frequency of the 15 symptoms, which range from 0, suggesting no symptoms, to 60, representing persistent symptoms. According to the types of

symptoms, the 15 items are divided into two subscales: vestibular (balance) (VSS−V), and autonomic-anxiety (VSS−AA)[75].

However, to use a PROM in a population with a language different from the source, it must undergo a process of cross−cultural adaptation, which includes both translation and cultural adaptation. However, translation of any validated PROM can debilitate its psychometric properties; therefore, consistency and validity should also be confirmed and reported in accordance with international guidelines for measuring patient-reported health outcomes[76]. The psychometric properties of the VSS−SF were assessed when Norwegian and Japanese versions were cross-culturally validated; both translated versions had acceptable internal consistency, external reliability, convergent validity, and discriminating validity. Two factors were explored in the Norwegian version: VSS-V and VSS-AA[77]; however, a third factor related to duration of symptoms was also extracted from the Japanese version[57].

Unfortunately, there is a critical shortage of validated tools in Kurdish that can quantify vestibular disorders. The VSS-SF is efficient, simple, short, and has not been adapted to Kurdish. Accordingly, in this study an adjusted translation and cultural adaptation of the VSS−SF to the Kurdish-central dialect (VSS−SF−KC) were applied. Utilizing a cross-sectional survey, and in accordance with the COSMIN checklist[71], its psychometric properties were also assessed.

3.3 Methods

3.3.1 Cross-cultural adaptation (translation and cultural adaptation)

The process was conducted according to the steps recommended by Wild and colleagues[33] and Beaton and colleagues[39] and. that is the below steps

3.3.1.1 The focus group (FG):

In accordance with international regulations for qualified PROMs[71], the institute assembled a FG, consisting of seven otolaryngologists (including the author) who were all native speakers of the target language with 15 to 25 years of experience in the field of vestibular speciality. The moderator of the group was aware of how to run the discussion sessions according to the corresponding guidelines[41].

3.3.1.2 Preparation:

Preparation consisted of three steps.

3.3.1.2.1 The author contacted and confirmed the permission of Professor Lucy Yardley as one of the original developers (Appendix 11).

3.3.1.2.2 A junior otolaryngologist (who could easily contact the members of the FG and the translators) was recruited to follow the translation process.

3.3.1.2.3 The concepts of clarity, fluency, and unambiguity in the forwarded translations were agreed upon and followed during the process of cross-cultural adaptation.

3.3.1.3 Translation

Two forwarded translations of the contents were performed by an expert native otolaryngologist (T_1) and a licensed native translator (T_2)

3.3.1.4 Cultural adaptation

To make the translated tool understandable by majority of the target population, the FG implemented the following steps:

3.3.1.4.1 Reconciliation: to create a pre-final copy, in two consecutive sessions, the FG, in the presence of the first translator, compared and resolved differences between T_1 and T_2; then, a preliminary form of VSS−SF−KC was created (T_{12}). Controversies were resolved by majority opinion.

3.3.1.4.2 Back translation: To examine the quality, the T_{12} was back-translated to the original language by a different licensed translator.

3.3.1.4.3 Resolving discrepancies: After back-translation, FG implemented a review, during which, the below four noticed discrepancies were resolved:

3.3.1.4.3.1 The Kurdish word used for “very often” was not explicit and was enforced by a popular word of Arabic origin.

3.3.1.4.3.2 To explain the word “spell,” two Kurdish words were used.

3.3.1.4.3.3 A clause was added to clarify the meaning of “dizziness.”

3.3.1.4.3.4 popular Arabic word was inserted in brackets to define the word “unsteady.”

3.3.1.4.4 Pilot test, a pilot test was conducted with 18 linguistically knowledgeable patients with vestibular symptoms. Utilizing a specific form designed for ratings (Appendix 12), members of the FG and participants in the pilot test were asked to give feedback on understandability and to rate the contents of each translated item.

3.3.1.5 **Finalization of cross-cultural adaptation**

The whole aforesaid processes and results of the ratings were reviewed by the FG; consequently, the face and content validity were excellently (93%) validated by the members of the FG (Appendix 13). Ultimately, after proofreading and cognitive debriefing, the final version was established (Appendix 14) and the details of the process were reported to the institute.

3.3.2 **Sample size**

Based on a subject-to-variable ratio of a minimum of 10 participants for each item[42] and factors extracted in previous research on the same instrument[57], it was estimated that 165 participants would be sufficient to observe the covariation among our 15 surface attributes; along with 30 healthy control participants for comparison.

3.3.3 **Setting**

Two well-equipped audio-vestibular tertiary clinics that cover a major proportion of the center and districts of Sulaimani Governorate, Iraq enrolled participants from March 2017 to July 2018.

3.3.4 Participants

Participants were patients with chief complaints of vestibular symptoms who had been objectively diagnosed as having vestibular disorders.

3.3.4.1 Inclusion and exclusion criteria

Native speakers with sufficient communication and performance abilities were included. The exclusion criteria were: age below 17 or above 79, symptoms of less than one-day duration (Patients needed to have experienced symptoms [a feeling of being dizzy, disoriented, or swimmy lasting all day] for at least one day in order to answer item-6), musculo-skeletal diseases and symptoms primarily due to other systems disorders such as neurological, cardiopulmonary, and cognitive disorders.

3.3.4.2 Subgroups

The heterogeneity of symptoms in the instrument required patients with different presentations and from different settings[22]; consequently, the inclusion and exclusion criteria were adjusted to ensure that the sample was a good representation of the target population (patients with vestibular symptoms of vestibular origin with no associated illnesses that may produce vestibular symptoms). The sample contained all types of patients that may be encountered in primary, secondary, and tertiary clinics. Furthermore, based on the patterns of presentation, and to evaluate the discriminating validity, the sample was classified into three subgroups:

3.3.4.2.1 Acute presentation (acute episode of symptoms at the time of rating).

3.3.4.2.2 Chronic presentation (long-term sensations of symptoms).

3.3.4.2.3 Episodic presentation (recurrent symptoms with symptom-free intervals)[78].

3.3.4.2.4 Reliability subgroup, For the 76 participants who were randomly selected from the patients included in the reliability subgroup, the design was converted to a short-term longitudinal study to assess external reliability.

3.3.5 Educational level and raters (interviewers)

The VSS−SF−KC is a self-rated survey tool, that is, the role of the rater (interviewer) is trivial[51] , but not everyone in the target population is literate, so participants' educational levels were documented. Methodologists also recommend the involvement of a female interviewer to simplify the process, considering participants' psychological and/or societal obstacles[79]; that is, female interviewers can interview both genders, particularly women in conservative or religious families. Hence, two female raters with similar qualifications and sufficient training were recruited.

3.3.6 Recruitment and randomization

While patients were waiting for the results of their investigations or rehabilitation protocols, a systematic numbered sample was used on a daily basis to select patient participants who fulfilled the inclusion criteria and accepted the invitation. The first participant was selected randomly followed by fixed-interval selection.

3.3.7 Comparators

To the best of our knowledge, there are no validated PROMs in Kurdish that measure the construct under investigation. Consequently, the following two comparators were

employed. Since they could measure a similar construct but using two different approaches, that is, subjective and objective:

3.3.7.1 **Subjective comparator**

A percentage rating, in other words, choosing a specified number as a fraction of hundred; that is, visual analogue scale (VAS) is a widely adopted tool used by the majority of people in this locality, even those who are illiterate. Additionally, VAS as an outcome measure has exhibited good psychometric properties[43]**.** Hence, a VAS was applied so patients could rate their total self-perceived vestibular symptoms (VAS−T). The scale started with zero to represent no symptoms and ended with 100 to represent subjectively rated as worst-possible symptoms.

3.3.7.2 **Objective comparator**

Tandem Romberg (TR) was utilized, a printed figure of two straight feet one in front of the other (toe to heel) without angulation glued on a stable flat ground. The test was carried out in a noiseless room; so that, the patient unable to get benefit from auditory information to maintain balance in eyes closed conditions. Participants were asked to stand quietly on the figure, each palm over the opposite shoulder looking forward. Participants were requested to maintain balance for 60 seconds under the following four conditions (Appendixes 15 and 16):

- 3.3.7.2.1 Right foot behind the left, eyes open.
- 3.3.7.2.2 Same as the first, eyes closed.
- 3.3.7.2.3 Left foot behind the right, eyes open.
- 3.3.7.2.4 Same as the third, eyes closed.

Times for each trial were calculated from beginning to end using a stopwatch. The beginning was considered to be when the patient adopted the condition and s/he was ready. While, the end was identified as comprising the following five situations:

3.3.7.2.1 When the participant could complete 60 seconds successfully; or failed to complete when s/he:

3.3.7.2.2 Moved palm or foot.

3.3.7.2.3 Lost balance.

3.3.7.2.4 Sought assistance (holding objects).

3.3.7.2.5 Opened eyes in eyes closed conditions.

Three trials were administered for each of the aforesaid conditions; however, only one trial was administered for each condition if the patient could complete 60 seconds successfully. Moreover, the third trial was only administered when the patient could not complete the first and the second trials. Number of seconds in the administered trial or trials in each condition were summed out of 60 seconds. The scores from all four conditions (TR−T) were summed out of 240 seconds[80].

3.3.8 External reliability

Steps recommended by Kottner and his colleagues were followed during reliability assessments and reporting[81]. Utilizing two raters (R_1 and R_2), patients in the reliability subgroup of VSS-SF-CK (n = 74) were rated on two separate occasions (O_1 and O_2). From these, 56 were randomly assigned for intra-rater tests (each subject was rated by the same rater on both occasions); 28 and 28 were rated by R1 and R2, respectively. The remaining 18 were enrolled for inter-rater tests (the subject was rated by both raters, each for one occasion); nevertheless, test-retest reliability was examined by comparing the results of both occasions. The time interval between ratings was one to five days, the timing of O_2 was arranged by the raters according to patient's availability while the patient returned to receive their results from the investigations or to repeat their rehabilitation protocols.

3.3.9 Measurement errors

3.3.9.1 Strategies

The following strategies were used to minimize measurement errors:

3.3.9.1.1 Participants with unstable conditions (dramatic recovery or deterioration) were excluded from the reliability tests.

3.3.9.1.2 The time interval between ratings was one to five days; furthermore, to avoid recall bias, the sequence of items for the second rating was different. However, the interval for Tandem Romberg was one to two hours to remove the effect of in-between rehabilitation.

3.3.9.1.3 Similar settings were applied to all patients; ratings were performed in a quiet room to eliminate distractions and minimize auditory stimuli, so patients could not maintain their balance using these stimuli, especially in eye closed conditions (to test vestibular system alone, the role of other systems, that could help in maintaining balance, should be excluded).

3.3.9.1.4 Raters were instructed not to prompt patients for specific answers.

3.3.9.1.5 To avoid missing values during rating, systematic non-reply of one of the responses especially (never = 0) was prevented[82]. VAS and TR were also exposed to the recommended regulations.

3.3.10 **Statistical road map**

3.3.10.1 **Data screening**

Ceiling and floor effects were absent, while the percentages of patients with the highest and lowest scores in the three outcome measures were below 15%[53]; pairwise exclusion was used with missing values. In our sample size (50< N <300), absolute Z-scores above 3.29 *were* considered to reflect a non-normal distribution[45]. Univariate and multivariate (Mardia test) statistics revealed an asymmetric distribution. Ordinal variables such as Likert-type items fail to assume normality[49, 57] and therefore require either log-transformation or distribution-free (e.g., nonparametric) tests; in this study, the latter was chosen[50].

3.3.10.2 **Structural validity**

Because there is no gold standard in the field of vestibular disorders[83], the authors validated the construct via the following parameters instead of the criterion:

3.3.10.2.1 Exploratory factor analysis (EFA): To identify the latent constructs, considering a sample size of (≤300) and non-normality[42, 49], the authors conducted EFA. Some methodologists recommend use of parametric tests even if the distribution is non-normal[84]. However, for ordinal data and non-normality, others advocate more robust tests, such as polychoric correlations (PC)[85], specifically, Robust Diagonally Weighted Least Squares (DWLS)[46]. In view of the study context, Principal Axis Factoring (PAF) was considered to outweigh maximum likelihood[49]. To certify that the same outcomes would be reproduced, and in light of the above circumstances, in EFA both PAF and DWLS were utilised. Assuming moderate inter-factor correlation (IFC), promax oblique rotation (Kappa = 4) was employed.

The partial least squares path modeling (PLS) is a stable statistic. Although it is a variance-based structural modelling, it can keep Type I error down in a non-normal distribution[55, 86]. SmartPLS software provides sufficient results in respect of construct and discriminant validity[60]. That is, PLS is also involved in EFA; yet, to agree with the purpose of the current study, the reflective measurement model (causality), default setting, and PLS algorithm were set.

3.3.10.2.2 Number of factors to retain: To avert bias, guidelines emphasize using diverse strategies for finding the ultimate number of internal attributes [49, 87]. This was resolved based on five parameters:

3.3.10.2.2.1 Kaiser Criterion (eigenvalue >1).

3.3.10.2.2.2 Scree plot.

3.3.10.2.2.3 Horn's parallel analysis (HPA)[88].

3.3.10.2.2.4 Minimum average partial (MAP).

3.3.10.2.2.5 The *a priori* hypotheses that the instrument consists of two subscales: VSS−V and VSS−AA[57, 77].

3.3.10.3 **Discriminant validity (internal discrimination)**

To establish this feature, four criteria were utilized:

3.3.10.3.1 Cross-Loadings Inspection: Item−loading on its construct should be higher than its cross-loadings.

3.3.10.3.2 Fornell-Larcker: The average variance extracted (AVE) by each factor should be higher than the square of IFC (IFC^2).

3.3.10.3.3 The heterotrait-monotrait ratio of correlations (HTMT) Value <0.85 is favorable.

3.3.10.3.4 HTMT−Inference: value <1 is assuring[89].

3.3.10.4 **Model fit**

This was appraised by a comparative fit index (CFI) value of ≥0.95 and the root mean square error of approximation (RMSEA) value of ≤0.06[90].

3.3.10.5 **External reliability**

Intraclass correlation coefficient (ICC) was utilized. The selection of raters (fixed) in this study governed ICC; that is, the two-way mixed-effect (model), mean of k raters (type), and absolute agreement (definition) were used to evaluate all types of reliability tests. Cut-off values for strength of reliability were: <0.5─poor, from ≥0.5 to ≤0.75─moderate, from ≥0.75 to ≤0.9─good, and >0.9─excellent[51].

3.3.10.6 **Internal consistency reliability**

The following seven variables were estimated and compared with the corresponding cut-off points:

3.3.10.6.1 Cronbach's alpha (α): >0.7[52, 91].

3.3.10.6.2 Average Inter-item correlation (AIC): ≥0.2≤0.5[53].

3.3.10.6.3 Corrected Item-total correlation (CI−TC): ≥0.4

3.3.10.6.4 Alpha if item deleted (AIID): the resultant α of the selected scale should not rise if any item is deleted[52].

Methodologists consider α to be a controversial estimate; accordingly, the following three parameters were also reported:

3.3.10.6.5 The consistent reliability measure of the partial least squares (rhoA): >0.7.

3.3.10.6.6 Composite reliability (rhoC): >0.7.

3.3.10.6.7 AVE by each factor: >0.5[55].

3.3.10.7 **Discriminating validity (external discrimination)**

Due to the ordinal nature of the data and non-normality, to determine this validity, methodologists recommend using medians instead of means and standard deviations[90]; hence, it was determined by Mann-Whitney U test which compared the medians of the scores in the three subgroups because the shapes of the their scales were similar. However, mean ranks were compared through the default Mann-Whitney test when control group was compared with the subgroups and the total patients because the shapes of their scales were not similar[56].

It is assumed that the instrument has the ability to discriminate between subgroups as well as between the patient and healthy groups. The Mann-Whitney U test was used to test this assumption with a significance level of 5%.

3.3.10.8 **Hypotheses**

Yardley stated that PROMs are cumulative measures, while objective tests are single-point measures[22]. Thus, we may find adequate correlations between subjective scores if they measure the same construct; however, the concept is not the same when subjective and objective scores are correlated even if they are measuring similar constructs[21, 77, 92]; accordingly, the following three hypotheses were formed:

3.3.10.8.1 The positive correlation between the total VSS−SF−KC score (VSS−T) and the VAS−T would be adequate, because they measure similar constructs with similar approaches.

3.3.10.8.2 The correlation between TR-T and VSS-V scores would be moderate because they measure similar constructs with different approaches; furthermore, the value would be negative (moderately negative) because low scores on TR-T are associated with high scores on VSS-V.

3.3.10.8.3 The negative correlation between TR−T and the VSS−AA would be weak because they measure different constructs with different approaches. Rank coefficient (Spearman) was used to estimate the correlations. The study classified values from assorted regulations as follows: <0.3─weak, ≥0.3<0.5─moderate, ≥0.5<0.7─adequate, and ≥0.7─high correlations[57, 58].

3.3.10.9 **Software**

Three programs were utilized: 1- FACTOR V10.8.04 (Rovira i Virgili University, Tarragona, SPAIN) for PC, HPA, and goodness of fit[93]; 2- SmartPLS 3. (Boenningstedt: SmartPLS GmbH)[60] for rhoA and discriminant validity; and 3- IBM SPSS Statistics V21 (IBM, Armonk, NY, USA) for the rest of the analysis such as, PAF, α and syntaxes for HPA and MAP[94].

3.3.11 Ethics approval and consent to participate

Approval (number 43C) was granted from the ethical committee of the College of medicine/University of Sulaimani, Iraq. The work was implemented in accordance with international guidelines and 2008 Declaration of Helsinki. Written informed consents were provided by participants.

The flowchart (**Figure 3.1**) illustrates the sequential order of the works implemented in the study.

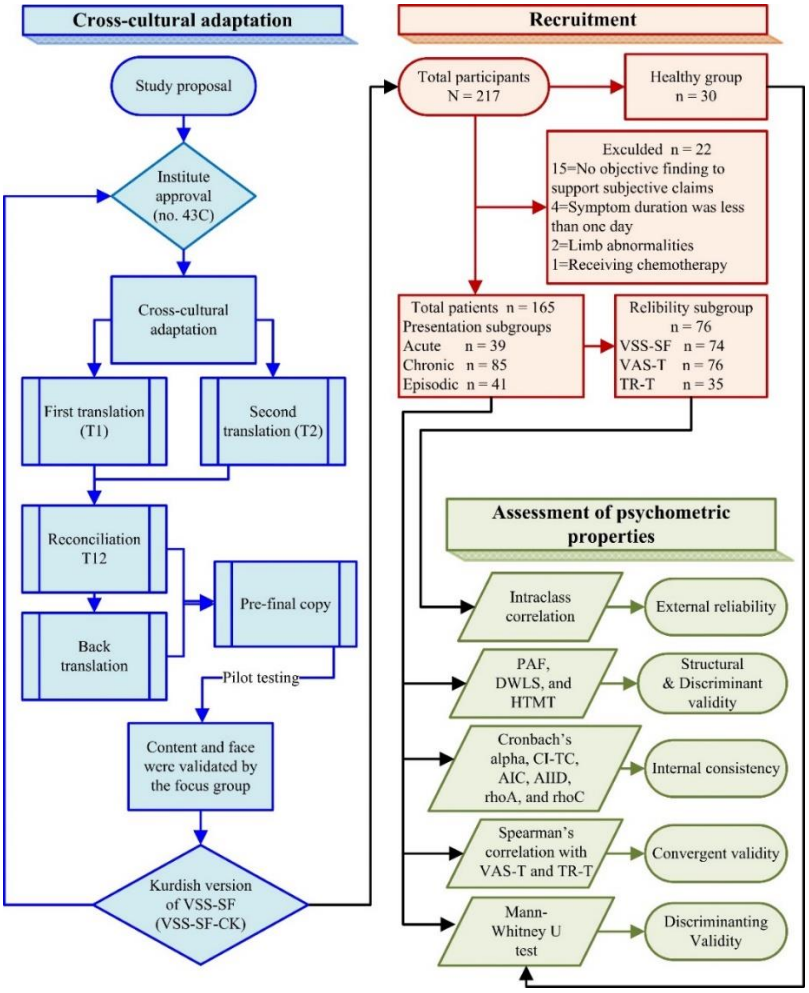

Figure 3.1 The course of the study

Note: Each color represents a specific field of work in the study; Black arrows show the sequential order and connections between the fields.
Abbreviations: VSS−SF/KC, Vertigo Symptom Scale−Short Form/Kurdish Central; VAS−T, Visual Analogue Scale−Total; TR−T, Tandem Romberg−Total; PAF, Principal Axis Factoring; DWLS, Diagonally Weighted Least Squares; HTMT, Heterotrait-monotrait ratio; CI−TC, Corrected Item-Total Correlation; AIC, Average Inter-item Correlation; AIID, Alpha If Item Deleted; rhoA, Reliability measure of the partial least squares; rhoC, Composite reliability.

3.4 Results

Data related to participants and exclusions are presented in **Figure 3.1**; no valid differences in the results were exhibited based on exclusions. Furthermore, more details of participants' attributes are shown in **Table 3.1**.

Table 3.1 Demographic attributes of the groups and subgroups.

	Total Patients		Reliability subgroup		Presentation subgroups[a]						Healthy group	
					Acute		**Chronic**		**Episodic**			
	n = 165		n = 76		n = 39		n = 85		n = 41		n = 30	
	n	%	n	%	n	%	n	%	n	%	n	%
Women	93	56.4	38	50	21	53.8	53	62.4	19	46.3	18	60
Age (year)[b]	45	±16	45	±17	45	±15	42	±16	53	±13	35	±18.6
Duration[bc]	4.5	±11.8	4.1	±14.7	0.5	±0.13	7.1	±14.9	3	±8.6		
Educational Level												
No or Primary[d]	92	55.8	43	56.6	21	53.9	41	48.3	30	73.2	5	16.7
Secondary[d]	42	25.5	19	25.0	9	23.1	28	32.9	5	12.2	20	66.7
Graduate & Post graduate	31	18.8	14	18.5	9	23.1	16	18.9	6	14.6	5	16.6
Diagnosis												
Labyrinthitis	1	0.5	1	1.3	1	2.6	0	0	0	0		
BPPV	17	8.7	7	9.2	2	5.1	0	0	15	36.6		
MD	18	9.2	11	14.5	2	5.1	4	4.7	12	29.3		
UPVH	59	30.2	28	36.8	32	82	18	21.2	9	22		
VM	15	7.7	5	6.6	2	5.1	9	10.6	4	9.8		
Other VD[e]	55	28.2	24	31.6	0	0	54	63.5	1	2.4		

Note: [a]Nature of the symptoms at the time of rating not related to disorders or syndromes; [b]Mean and ±Standard Deviation; [c]Duration in month; [d]Schools; [e]No specific diagnosis could be identified.

Abbreviations: BPPV, Benign Paroxysmal Positional Vertigo; MD, Meniere's Disease; UPVH, Unilateral Peripheral Vestibular Hypofunction; VM, Vestibular Migraine; VD, Vestibular Disorders.

Factorability was achieved, the determinant was not equal to zero (0.007), the Kaiser-Meyer–Olkin test was meritorious (0.873), and Bartlett's test of sphericity was significant ($p<0.001$). Based on eigenvalues >1, PAF revealed three factors. On this basis, a 3-factor solution was applied using DWLS. The cumulative proportions of variance (CPV) in the three factors were 53% and 59% in PAF and DWLS,

respectively. In the case of DWLS, the three consecutive eigenvalues and the CPV were 6.2 (41%), 1.6 (52%), and 1.1 (59%). Nonetheless, the elbow of the scree plot was distinctly flexed at the point where the second factor was located (**Figure 3.2**). Furthermore, HPA (**Table 3.2**), MAP (**Table 3.3**) and the a priori hypothesis also supported the scree plot display; that is, a 2–factor solution.

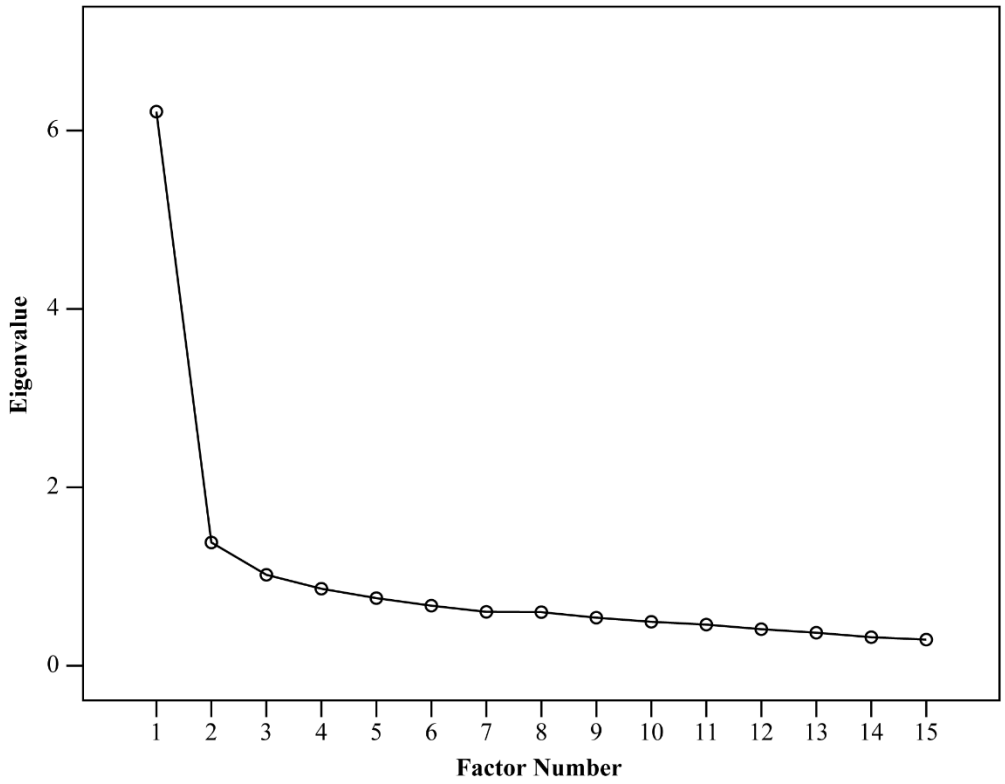

Figure 3.2 Scree plot of the initial exploratory factor analysis, based on Eigenvalues >1

Note: The flexion of the elbow at the second factor is maximal denoting 2 factors retaining.

Consequently, a 2–factor solution was conducted with both PAF and DWLS. Two factors were extracted: vestibular (VSS−V) and autonomic-anxiety (VSS−AA), In the case of DWLS, the two consecutive eigenvalues and the CPV were 6.1(41%), 1.6

(52%). Each factor adequately loaded seven items with weak cross-loadings. The remaining Item–12 (feeling faint, about to black out), was loaded adequately by the VSS−AA; however, it was associated with noticeable cross loadings by VSS−V.

Table 3.2 Generated data from the syntax of parallel analysis.

Component	Raw data Eigenvalue	Mean	Random data Eigenvalue
1	4.728047	.646551	.793333
2	.914256	.513729	.611101
3	.463210	.413163	.492010
4	342032	.321345	.387580
5	254970	251837	326927
6	.126855	.176483	.231430
7	.087036	.113714	.168414
8	-.026161	.052747	.108982
9	-.052582	-.008164	.037287
10	-.104527	-.064487	-.020644
11	-.136085	-119741	-.071196
12	-.164388	-.176355	-.144788
13	-.176476	-.228860	-.196435
14	-.219167	-.281834	-.249937
15	-.282802	-.342770	-.298055

Note: Raw data permutation in principal axis factoring showed that the Eigenvalues of the raw data is greater than that of the percentile random data only in the first and second components; that is, the suggested number of components is: 2.

The AVE by neither method reached the acceptable level, as it was <0.5 for both factors. A downloadable file (Additional file 5) of a publication[95] related to this dissertation shows how to estimate AVE and rhoC.

To assess the negative effects of low AVE on discriminant validity, AVE and IFC2 were compared (Fornell-Larcker criterion). In PAF, the AVE by both factors were lower than IFC2 (validity not established); while for DWLS, AVE was higher than IFC2 only in VSS−V (validity of one factor established). However, the validity was confirmed by HTMT value=0.71 (<0.85) and HTMT-inference value=0.81 (<1).

Table 3.3 Generated data from the syntax of minimum average partial.

Eigenvalues	Component	Squared	Fourth power
4.6729	.0000	.3125	.1551
1.7710	1.0000	.2451	.0736
.4810	2.0000	.0664	.0119
.4214	3.0000	.1276	.0519
.2332	4.0000	.2042	.1160
.1867	5.0000	.2718	.1526
.1373	6.0000	.4346	.3312
.0965	7.0000	1.0000	1.0000

Note: Velicer's minimum average partial test; The smallest average squared partial correlation is: 0.0664; The smallest average fourth power partial correlation is: 0.0119; The number of components according to the original (1976) MAP test is: 2; The number of components according to the revised (2000) MAP test is: 2 (these notes were generated from the syntax).

To examine the situation, we deleted item−12 (the cross-loading item), then we rerun the analysis; consequently, in DWLS, the AVE by VSS–AA was slightly inflated and became more than a slightly deflated IFC[2]; hence, the Fornell-Larcker criterion was also achieved for the VSS−AA (**Table 3.4**).

Moreover, **Figure 3.3** shows the outer items loading estimates by both factors, using reflective measurement model, default setting, and PLS algorithm.

Another downloadable file (Additional file 6) of same publication[(95)] related to this dissertation shows the details of 2-factor extraction by DWLS and the results of model fit, CFI = 0.985 (≥0.95) and RMSEA = 0.049 (≤0.06).

Additionally, **Table 3.4** and **Figure 3.4** present the outcomes for the internal consistency variables, they were satisfactory for all methods and scales; regarding AIID, resultant α did not increase when any item was deleted. In both methods, values of rhoA and rhoC gained the acceptable limits.

The instrument and the comparators exhibited good to excellent reliabilities in all types **(Table 3.5)**.

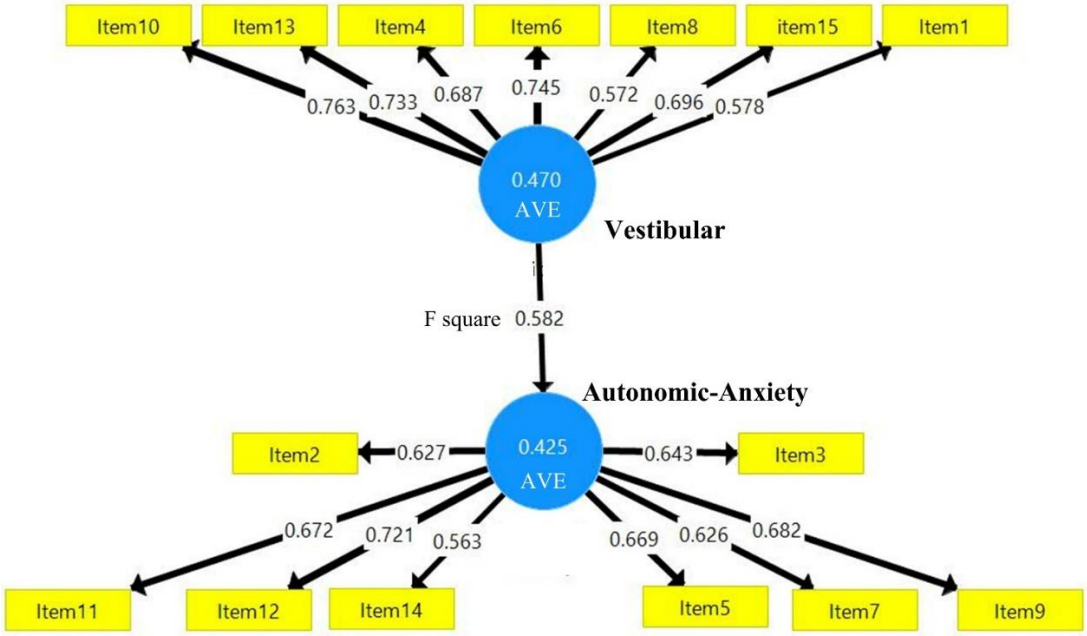

Figure 3.3 Outer items loading estimates by two factors, using reflective measurement model, default setting, and PLS algorithm

Note: values inside the latent variables represent the average variance extracted by each factor; Value of f-square greater than 0.3 represent medium to large magnitude of effect (effect size) of vestibular factor on the autonomic-anxiety factor.
A bbreviations: AVE, Average Variance Extracted; PLS, Partial least squares path modeling.

Table 3.4 Item loadings in exploratory factor analysis with 2–factor solution and the internal consistency variables.

	Kurdish Sample[a]								Norwegian Sample[b]	
	n = 165								n = 509	
	Internal consistency variables				**Polychoric Correlations[c]**		**Principal Axis Factoring[d]**		**Maximum Likelihood[e]**	
	CI-TC in subscales	AIID in subscales	CI-TC in total scale	AIID in total scale	Factor 1 Vestibular	Factor 2 Anxiety	Factor 1 Vestibular	Factor 2 Anxiety	Factor 1 Vestibular	Factor 2 Anxiety
VSS–V		**0.809**								
4- Vertigo (>20 minutes)	0.56	0.783	0.49	0.862	0.91	-0.17	0.76	-0.15	0.84	-0.18
10- Unsteady (>20 minutes)	0.63	0.768	0.58	0.857	0.85	-0.06	0.76	-0.05	0.80	-0.01
13- Unsteady (<20 minutes)	0.60	0.773	0.56	0.858	0.74	-0.03	0.72	-0.04	0.58	0.14
6- Dizziness (all day)	0.59	0.777	0.61	0.855	0.58	0.21	0.53	0.19	0.81	-0.10
8- Difficult to stand or walk	0.45	0.800	0.41	0.865	0.54	-0.03	0.52	-0.03	0.67	0.07
15- Dizziness (<20 minutes)	0.55	0.784	0.55	0.858	0.54	0.18	0.47	0.19	0.60	0.10
1- Vertigo (<20 minutes)	0.44	0.801	0.43	0.864	0.52	0.04	0.46	0.05	0.61	0.09
VSS–AA		**0.807**								
9- Difficulty in breathing	0.57	0.779	0.52	0.860	-0.05	0.78	-0.07	0.69	0.02	0.55
14- Chest pain	0.46	0.794	0.40	0.865	-0.10	0.71	-0.14	0.63	0.05	0.45
7-Headache	0.51	0.787	0.46	0.863	-0.09	0.69	-0.11	0.66	0.33	0.33
11- Excessive sweating	0.55	0.781	0.53	0.860	0.06	0.59	0.06	0.56	0.09	0.82
3- Nausea, vomiting	0.52	0.785	0.50	0.861	0.05	0.59	0.07	0.52	0.35	0.31
2- spells of cold or hot	0.49	0.790	0.51	0.861	0.07	0.56	0.12	0.47	-0.02	0.81
5- Heart fluttering	0.51	0.788	0.54	0.859	0.20	0.50	0.16	0.48	-0.04	0.56
12- Feeling faint	0.55	0.781	0.62	0.855	0.33	0.45	0.30	0.43	0.43	0.32
VSS–T				**0.868**						
AVE					0.47	0.38	0.38	0.32		
IFC (IFC²)					0.63	(0.40)	0.65	(0.42)	0.56	(0.31)
RhoC					0.86	0.83	0.80	0.78		
RhoA[f]					0.82	0.82				
If item–12 deleted[g]										
AVE					0.47	0.40	0.37	0.33		
IFC (IFC²)					0.62	(0.38)	0.62	(0.39)		
RhoC					0.85	0.82	0.80	0.77		
AIC	VSS–V = 0.38			VSS–AA = 0.34			VSS–T = 0.31			

Note: For convenience, symptoms shortened; Alphas of the subscales and total scale are in bold and in three decimal places, to be compared with resultant alpha when any item deleted; [a]Promax, Kappa=4; [b]Wilhelmsen K, Strand LI, Nordahl

SHG, Eide GE, Ljunggren AE. Psychometric properties of the Vertigo symptom scale - Short form. BMC Ear Nose Throat Disord. 2008;8:2; [c]Polychoric algorithm by Diagonally Weighted Least Squares (DWLS); [d]Promax with Kaiser normalization in 3 iterations; [e]Oblimin, Delta=0; [f]Values provided by SmartPLS 3; [g]Inflation of AVE and deflation of IFC^2.
Abbreviations: VSS–V/AA/T, Vertigo Symptom Scale–Vestibular/Autonomic-Anxiety/Total; CI-TC, Corrected Item-Total Correlation; AIID, Alpha If Item Deleted; AVE, Average Variance Extracted; IFC, Inter-Factor Correlation; IFC^2, Square of IFC; RhoC, Composite reliability; RhoA, Reliability measure of the partial least squares; α, Cronbach's alpha; PLS, Partial Least Squares; AIC, Average Inter-item Correlation.

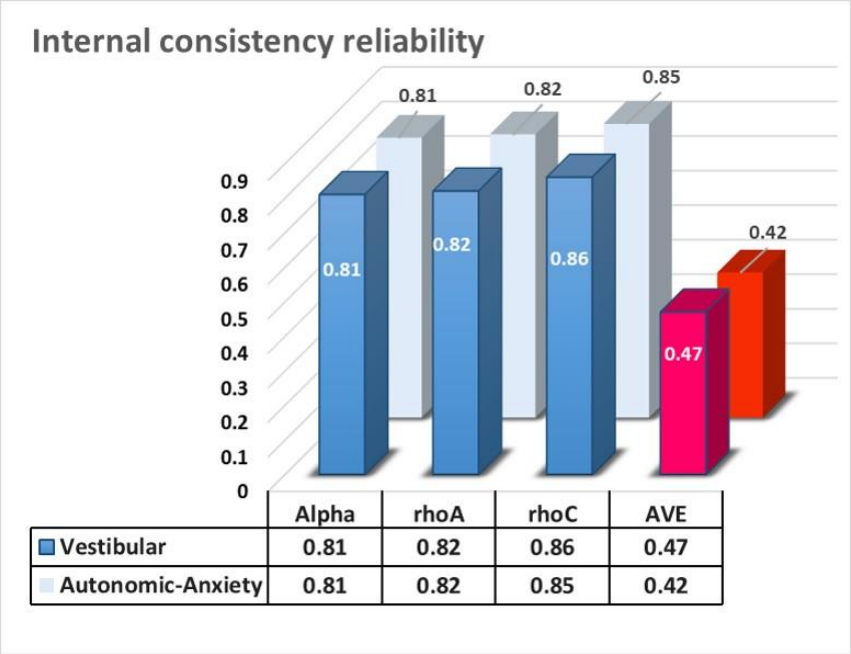

Figure 3.4 Inter-item internal consistency parameters and average variance extracted in two factors
Notes: values provided by SmartPLS via confirmatory factor analysis by PLS; the color is different in AVE because values are <0.5.
Abbreviations: PLS, partial least squares path modeling; Alpha, Cronbach's alpha; rhoA, consistent new reliability estimate of PLS; rhoC, Composite reliability; AVS, Average variance extracted.

Table 3.5 External reliability of the instruments.

	VSS−SF−KC n = 74						n = 76		n = 35	
	VSS−V		**VSS−AA**		**VSS−T**		**VAS−T**		**TR−T**	
	ICC[a]	n	ICC[a]	n	ICC[a]	n	ICC[a]	n	ICC[a]	n
Intra-rater1	0.88	28	0.93	28	0.95	28	0.98	28	0.95	12
Intra-rater2	0.83	28	0.96	28	0.97	28	0.90	29	0.80	13
Inter-rater	0.97	18	0.93	18	0.97	18	0.96	19	0.91	10
Test-retest	0.93	74	0.94	74	0.97	74	0.96	76	0.90	35

Note: [a]Intraclass correlation coefficient: the model, two-way mixed effects; the type, mean of k raters; and the definition, absolute agreement.
Abbreviations: VSS–SF–KC/V/AA/T, Vertigo Symptom Scale–Short Form–Kurdish Central/Vestibular/Autonomic-Anxiety/Total; VAS–T, Visual Analogue Scale–Total; TR–T, Tandem Romberg–Total.

Table 3.6 shows the Spearman's correlations between VSS−SF−*KC* and its subscales, VAS−T, and TR−T (Pearson's correlations revealed similar results [**Table 3.7**]).

Table 3.6 Spearman's correlation of the scales with the comparators.

	n = 165		n = 159	n = 143
	VSS-V	**VSS-AA**	**VAS-T**	**TR-T**
VSS-V			0.48[a]	**-0.37[a]**
VSS-AA	0.58[a]		0.52[a]	**-0.14[b]**
VSS-T	0.85[a]	0.91[a]	**0.57[a]**	-0.27[a]

Note: Correlations stated in the hypotheses are in bold; [a]Correlations are significant at the level of 0.01; [b]Correlations are significant at the level 0.05.
Abbreviations: VSS–V/AA/T, Vertigo Symptom Scale–Vestibular/Autonomic-Anxiety/Total; VAS–T, Visual Analogue Scale–Total; TR–T, Tandem Romberg–Total.

Table 3.7 Pearson's correlation of the scales with the comparators.

	n = 165		n = 159	n = 143
	VSS-V	**VSS-AA**	**VAS-T**	**TR-T**
VSS-V			0.47[a]	**-0.42[a]**
VSS-AA	0.58[a]		0.50[a]	-0.17[b]
VSS-T	0.87[a]	0.91[a]	**0.55[a]**	-0.32[a]

Note: Correlations stated in the hypotheses are in bold; [a]Correlation are significant at the level of 0.01; [b]Correlation are significant at the level 0.05.

Abbreviations: VSS-V/AA/T, Vertigo Symptom Scale-Short Form-Vestibular/Autonomic-Anxiety/Total; VAS-T, Visual Analogue Scale-Total; TR-T, Tandem Romberg-Total.

The Mann-Whitney U test compared the medians of the scores and revealed that the distributions were similar in all scales across subgroups (*ps* > .05). However, they were not similar when the mean ranks of the control group were compared to that of the subgroups and total patients (*ps* < .05). the medians and interquartile ranges of the scales are shown in **Table 3.8** and **Figure 3.5**.

Table 3.8 Median and interquartile range of the scales.

	Total patients		Reliability subgroup		Presentation subgroups[a]						Healthy group	
					Acute		**chronic**		**Episodic**			
	n = 165		n = 76		n = 39		n = 85		n = 41		n = 30	
	M	IQR	M	IQR	M	IQR	M	IQR	M	IQR	M	IQR
VSS-V	8	7	8	7	7	7	8	8	7	7	**0**	**1**
VSS-AA	10	10	10.5	11	9	10	11	11	9	10	**3**	**5**
VSS-T	18	16	18.5	18	18	16	20	17	16	15	**3**	**6**

Note: [a]Nature of the symptoms at the time of rating, not related to disorders or syndromes; Bold values are median and IRQ of the healthy group.
Abbreviations: M, Median; IQR, Interquartile range; VSS-V/AA/T, Vertigo Symptom scale-short form-Vestibular/Autonomic-Anxiety/Total.

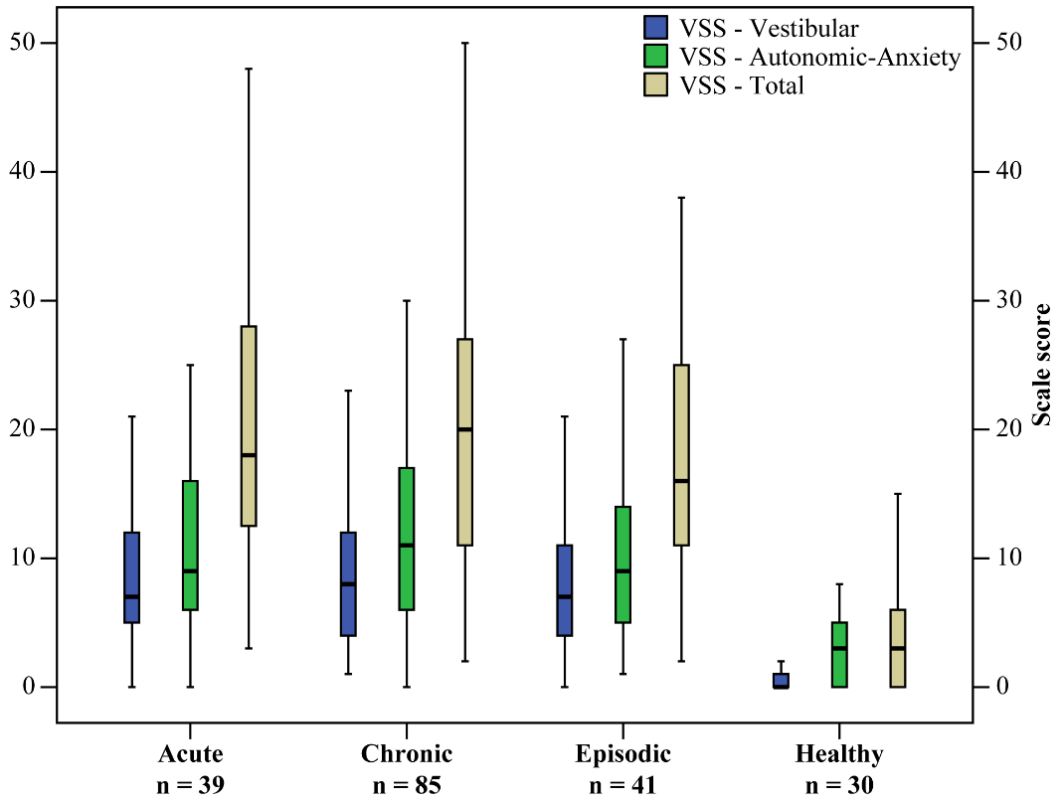

Figure 3.5 Shape and distribution of the scores in subgroups and healthy group
Note: Subgroups were classified based on the pattern of presentations of the vestibular symptoms at the time of rating
Abbreviation: VSS, Vertigo Symptom Scale

3.5 Discussion

The study utilized a regulated process of cross-cultural adaptation and produced a VSS−SF−KC. The steps as described in the methodology were mostly applied in accordance with the related guidelines.

The nature of both the population and sample obliged the authors to involve raters (interviewers) and transform the instrument, as necessary, from self-administered to interviewer-administered (e.g., in cases of non-motivated and illiterate participants). The reliabilities of the VSS−SF−KC and the comparators were enhanced by these measures which was consistent with the test-retest results of the Norwegian and Japanese versions.

The results of both DWLS and PAF were nearly similar during EFA: seven items (1, 4, 6, 8, 10, 13, and 15), which are directly related to VD, firmly loaded onto vestibular factor with weak cross-loadings to the autonomic-anxiety factor; this was a preliminary sign of the discriminant ability of the VSS−V.

Previous studies as well as the present survey have used various types of analyses and samples; however, across these samples, two items (items-3 and 12) were associated with loading issues.

In five previous samples (Mexican, U.K. hospital, U.K. primary care, Norwegian [Table 4], and Japanese), item−3 (nausea, vomiting) loaded interchangeably on both factors with noticeable cross-loadings on every occasion[26, 57, 77]. The mean loading (calculated by the authors) in these samples showed that the reflective–effect of anxiety factor on item–3 (loading 0.41) was higher than that of vestibular (loading 0.35).

The story of item-3 began when the original developer, intentionally decided to retain the item along with other items in VSS-V for several purposes[26], knowing that, this

item originally belongs to VSS-AA from the physiological point of view[96]. Face validity, was one of the purposes for retaining the item; this is justifiable for other item like falling and short dizziness (which retained along with item-3); while regarding nausea and vomiting the notion is different. Face validity is a subjective and first impression judgment, denoting that the items are reflecting their construct**[76]**; ie, if the item is a mirror, one should see the face of only one construct, and if any other construct is visible it should not be more than a shadow. However, when we looked to item-3 in these samples, the face of VSS-AA was more apparent than VSS-V. The other cause for retaining was severity evaluation; of this, the ranges of response are already set to measure the frequency (severity), so each item can measure the severity through its construct. Furthermore, the retaining slightly inflated the correlation between constructs, and that is the other downside from the view of discriminant validity. However, item-3 in the recent sample has returned to reflect mainly one face, i.e., VSS-AA; as it was strongly loaded by this factor (**Table 3.4**), which can be attributed to the heterogeneous nature of the symptoms in this sample; that is, various presentations and durations.

The item−12 cross-loading issue (feeling faint, about to black out) is perhaps a structural matter. Out of six samples including the present survey, four of them included item−12 correctly with VSS−AA[26, 57, 77]; the order, starting from weaker cross-loadings, was U.K. primary care, Japanese, U.K. hospital, and then the present sample. In the remaining two samples, the item unexpectedly settled on VSS−V; the order, starting from stronger loadings, was Norwegian then Mexican. It is unexpected for an item to oscillate or cross-load between constructs unless it is flawed. Accordingly, we believe this item represents two different types of symptoms. The words are clear and assumed to belong to the autonomic-anxiety symptoms; however, we noticed that some patients tried using many words or clauses to describe strange feelings of dizziness (spatial disorientation), words that were similar to those used to describe fainting and/or being about to black out. In spite of this, in the present study, item−12 loaded

adequately on VSS−AA (0.45); however, it was the only item characterized by the lowest loading and the highest cross-loading.

The situation was investigated by deleting item−12, which resulted (in both methods) in deflation of IFC and slight inflation of AVE by VSS−AA (**Table 3.4**). Consequently, the Fornell-Larcker criterion was also obtained for VSS−AA, leading to establishment of discriminant validity.

Regarding the 15 items' structural consistency, the item loading results in both methods were nearly similar, but the robustness of polychoric correlation via DWLS was evident through higher AVE and item-loadings. The two-factor model in the VSS−SF−KC was suitable according to the recommended fit indices. Along with structure, the construct was also validated across internal consistency parameters such as αs, rhoA, and rhoC, and it was clear from the results that all values achieved desirable levels. Despite the low AVE, discriminant validity was also established by both HTMT and HTMT-inference, while the Fornell-Larcker criterion was obtained for only one factor, VSS−V.

The hypotheses regarding convergent validity were supported. An adequate positive correlation was found between VSS−T and VAS−T as well as a moderate negative correlation between the VSS−V and stability; the latter replicated a similar correlation (between VSS-V and path length) in a previous analysis[77]. Although the types of scores in VSS−AA and TR−T are different (subjective and objective), the resultant weak negative correlation between them in Table 6 (-0.14) indicates the divergent ability of the VSS−AA because they measure two different constructs (anxiety and stability).

The instrument significantly discriminated the healthy group from the patients' group and subgroups; however, it was not efficient in discriminating presentation subgroups, most probably because patients narrated the sum of their symptoms from the onset, regardless of the presence or absence of symptoms at the time of rating; as Yardley

stated, the score is a cumulative measure[22]. The interpretability and responsiveness were beyond the scope of this study.

3.5.1 Strengths and limitations

We believe that the study's strength is its sample being representative of the target population. However, a potential limitation was related to convergent validity, as there were no validated comparator PROMs in Kurdish that could measure the same construct; for that reason, we utilized VAS and emphasized discriminant validity. Second, close observation was required to sustain patients' motivation for self-rating; and finally, because of the accommodation issue, we were obliged to shorten the minimum interval between rating events to one day.

3.6 Conclusion and recommendation

The VSS−SF was cross-culturally adapted to Kurdish. It revealed high external reliabilities. The structure of the 2-factor model was associated with high internal consistency and composite reliability with the ability to discriminate two latent variables (vestibular and autonomic-anxiety). These stabilities were confirmed by goodness of fit indices. It has adequate correlations with the comparators, demonstrating convergent validity. VSS−SF−KC is, then, a consistent and validated PROMs that can be used by Kurdish researchers and clinicians to quantify vestibular symptoms before and/or after treatment protocols.

3.7 Availability of data and materials

The datasets supporting the conclusions of this article are included within Additional file 7 and 8 of a publication related to this dissertation [95].

Chapter 4 Video Optokinetic Training in Rehabilitation for Patients with Unilateral Peripheral Vestibular Disorders in Sulaimani Governorate, Iraq

4.1 Abstract

4.1.1 Backgrounds

Patients with diminished vestibular cues in chronic vestibular disorders overlie on visual cues; hence, they develop visual dependency. Accordingly, they complain from visually induced vestibular symptoms and/or reduced stability in visually conflicted environments. Optokinetic stimulation enhances vestibular adaptation, thereby reduce visual dependency, decrease symptoms, and improve stability.

4.1.2 Objective

The primary aim of this trial was to assess the effectiveness of video optokinetic training protocol on patients with chronic unilateral peripheral vestibular disorders having visually induced vestibular symptoms.

4.1.3 **Methods**

The study used a randomized double blinded controlled trial to recruit participants from two major tertiary audio-vestibular clinics. Participants (n =122) were randomly allocated 57 patients to control groups (mean − age 41.3 ± 12.1; range 47 years; 54% women) and 65 patients to experimental group (mean − age 40 ± 12; range 47 years; 53% women). In the first five-weeks, both groups received a Modified Cooksey ─ Cawthorne Exercise Protocol (MCP); further, the experimental group has also received a formulated Video Optokinetic-training protocol (VOP). During the next five-weeks the control group continue to receive MCP with VOP; however, the experimental group stopped to receive any protocol. To measure the baseline scores and successive five-weeks and ten-weeks change in the health status, three primary outcome measures; that is, (Visual Dependency measures [VDM], Visual Vertigo Analogue Scale [VVAS], and Clinical Test of Sensory Interaction and Balance [CTSIB]) and two other secondary outcome measures (OMs) were used.

4.1.4 **Results**

The baseline nominal and numeric variables were test for successfulness of randomization; independent-samples test revealed that both groups belong to the same population and none of the variables was dependent on any group ($p < .05$). Five-weeks VOP has effectively reduced the scores of all OMs, primary and secondary ($p < .05$); however, the effect sizes were small (ES < 0.3). Dependent-samples tests revealed that combined MCP and VOP for five-weeks has substantially diminished the scores ($p < .05$, ES > 0.3).

4.1.5 **Conclusion**

VOP for five-weeks is an efficient protocol in reducing visual dependency in patients with chronic unilateral peripheral vestibular disorders. It diminishes vestibular symptoms and their concomitant autonomic-anxiety symptoms; further, it decreases the physical, emotional, and functional impacts of vestibular disorders. Lastly, it also improves stability in visually conflicted environment.

However, its size of effect would be much larger when both MCP and VOP are applied for five weeks.

4.2 Introduction

Vestibular disorders generate a group of symptoms, that is, vertigo, dizziness, vestibulo-visual symptoms, and postural symptoms[10]. These symptoms are frequent, exhausting[68]; furthermore, they are prevalent in the population and among patients visiting outpatient care centers[69, 70, 97]. Nevertheless, surveys related to epidemiology of vestibular disorders have rarely been implemented[68]; and a few conducted studies have reported a discordant range of one year prevalence ranging from 5.5 to 27%[98, 99].

The etiology of vestibular disorders can be attributed to pathology related to diseases or trauma affecting the central component (brain) and/or peripheral component (inner ear)[15]. However, because of the symmetrical replication of the system at the periphery (right and left), most of the common vestibular disorders are related to left-right asymmetrical activity; that is, unilateral peripheral vestibular disorders (UPVD) are noticeably the most common type of peripheral vestibular disorders[12, 13].

UPVD affects the motor and sensory functions and lead to two group of symptoms; that is, static and dynamic symptoms. Static symptoms are typically occur during the acute stage of the disorder (present even in the absence of head movement) such as vertigo, postural instability, and autonomic symptoms like nausea and vomiting[13]. After a few days, the central compensation commences and equalize the resting neural activity on both sides, consequently, these symptoms disappear. However, because of impairment of vestibulo-ocular reflex (VOR) and subsequent incoordination between head and eye movement (visual vestibular mismatch), some symptoms remain permanent and typically present during head movement; that is dynamic symptoms, such as blurry vision, decreased dynamic visual acuity, and disorientation triggered by visually unstable complex surroundings visual vertigo[13, 100, 101] or recently visually induced dizziness[10].

The sensory conflict produced by the visual vestibular mismatch enhance active central neuronal changes leading to vestibular adaptation and compensation[102]. However, several factors have been postulated to prolong the persistence of symptoms[14] and occasionally patients (20%) adopt maladaptive postural strategies; accordingly, they enter the phase of chronic vestibular insufficiency[100, 102].

An experience called visual dependency [103] is considered to be one of the aforementioned factors[14]; in this situation, the patient substitute the diminished vestibular cues by over-reliance on visual cues to maintain balance particularly during chronic stage of the disorder[104]. Consequently, they become sensitive to moving environment[16] and experience vertigo and/or dizziness whenever they are exposed to complex and/or moving visual surroundings[105].

Medications and surgery have offered limited solutions in considerable number of chronic vestibular disorders[15]. Necessarily, vestibular rehabilitation therapy has increasingly obtained approval and popularity so that it recently becomes the standard approach in numerous type of vestibular disorders[16]. Moreover, there is a moderate to strong evidence that the approach is safe and effective particularly for patients with stable but non-compensated UPVD[15, 16]. Vestibular rehabilitation therapy is a physiologic dependent therapy, through a repetitive exercise it aims to stimulate and enhance the neuroplasticity of the vestibular system and its central connections; hence, relieving symptoms and restoring balance through its natural processes; that is, adaptation, substitution, central programming, and recovering postural strategies[102, 106]. The exercise protocols can be group activities and/or customised exercise targeting particular needs[15, 107].

The first protocols that utilized group activities (eye, head, and trunk movements) has been introduced by Cooksey and Cawthorne (CCE) at 1940[108]; from then on, it has been extensively utilized and proved to be effective in improving dynamic balance[109,

[110]. However, with the progress of our perception to vestibular mechanisms, recently further customized protocols have been introduced to the vestibular rehabilitation apparatus in order to enhance specific response of the system; that is, adaptation, compensation, substitution, and postural control strategies[15]; besides, evidences indicated that addressing specific deficit with customized exercises is associated with effectual outcomes[111, 112].

The diminished ipsilateral VOR gain in UPVD leads to considerable amount of retinal slip during head movement; that is, gaze instability[113]. However, the vestibular system in these patients retain its plasticity and ability to adapt with the new situation, it persistently changes its neuronal response to head movement aiming to increase the VOR gain; hence, decrease retinal slip and stabilize the image[104].

One potential way to facilitate adaptation by enhancing the VOR gain and reducing retinal slip is exposing the patient to visual sensory conflicts; that is, optokinetic stimulation[17]. Consequently, this exposure has reduced visual dependency and improved visual vertigo symptoms in patients with peripheral vestibular disorders[18]. For convenience, patients can use home environment for optokinetic-training; while they are sitting, standing, and/or walking they can look at videos containing inharmonious moving visual scenes either on television or computer screens such as car chases and/or several shapes moving in different directions[19].

Gabrielle Pierce, a doctor of physiotherapy, has created a YouTube channel related to optokinetic-training in vestibular dysfunction. It contains different videos specifically produced to initiate optokinetic responses through scenes that contains complex moving patterns such as pulsing, waving, wrapping, and shifting checkerboards, as well as videos of driving over roads bridges in forward and reverse directions. Video optokinetic-training is easy to prescribe, patients enjoy to use such a technology, and it conveniently applied in regular home settings[20].

To our best knowledge, to date, the aforementioned videos have not been utilized for optokinetic-training. The recent study has utilized a double blinded controlled interventional study to assess its primary objective; that is, the effectiveness of a formulated video optokinetic-training protocol; and a formulated modified CCE protocol in rehabilitation of patients with chronic non-compensated UPVD.

Chapter 2 and 3 in this dissertation have demonstrated in details the process of cross-cultural validation of DHI-CK and VSS-SF-CK; however, because of the lack of repeated measures in the aforementioned processes, their responsiveness has not been examined. Consequently, the study has utilized these two validated PROMs and examined their responsiveness as its secondary objective.

4.3 Methods

4.3.1 Ethics

The study was started after earning the approval (no. 43D) from Ethical Committee of the College of Medicine, Sulaimani University, Sulaimani governorate, Kurdistan Region, Iraq. It was conducted in accordance with ethical principles related to medical research when it involves human subjects, principles that established and announced in Helsinki's deceleration (2008). Patients who fulfilled the inclusion criteria were invited to hear a short explanatory notes about the study and invited to participate. Those who accepted the invitation have signed an informed written consent.

4.3.2 Settings and participants

4.3.2.1 Setting

The recruitments occurred in two well equipped audio-vestibular tertiary centers in Sulaimani Governorate, Iraq. It was started from February 2017 to March 2019.

4.3.2.2 Inclusion criteria

4.3.2.2.1 Patients with acceptable physical and performance ability.

4.3.2.2.2 Aged between 18 and 65 years.

4.3.2.2.3 Having visually induced vestibular symptoms.

4.3.2.2.4 Positive positional test (direction fixed disappear on visual fixation).

4.3.2.2.5 Having received a diagnosis of chronic unilateral peripheral vestibular disorders for at least two months' duration.

4.3.2.2.6 Have passed the cognition test; that is, Mini-Mental State Examination.

4.3.2.3 **Exclusion criteria**

4.3.2.3.1 Episodic, irritative, fluctuating, and recovering vestibular disorders.

4.3.2.3.2 Age below 18 and above 65.

4.3.2.3.3 Disorders that might affect performance of the protocols such as musculoskeletal disorders.

4.3.2.3.4 Associated disorders that may produce vestibular symptoms.

4.3.2.3.5 Participants who performed less than 80% of the protocols.

4.3.2.3.6 Suspected bias responses; that is non-interested, halo, and prestige biases.

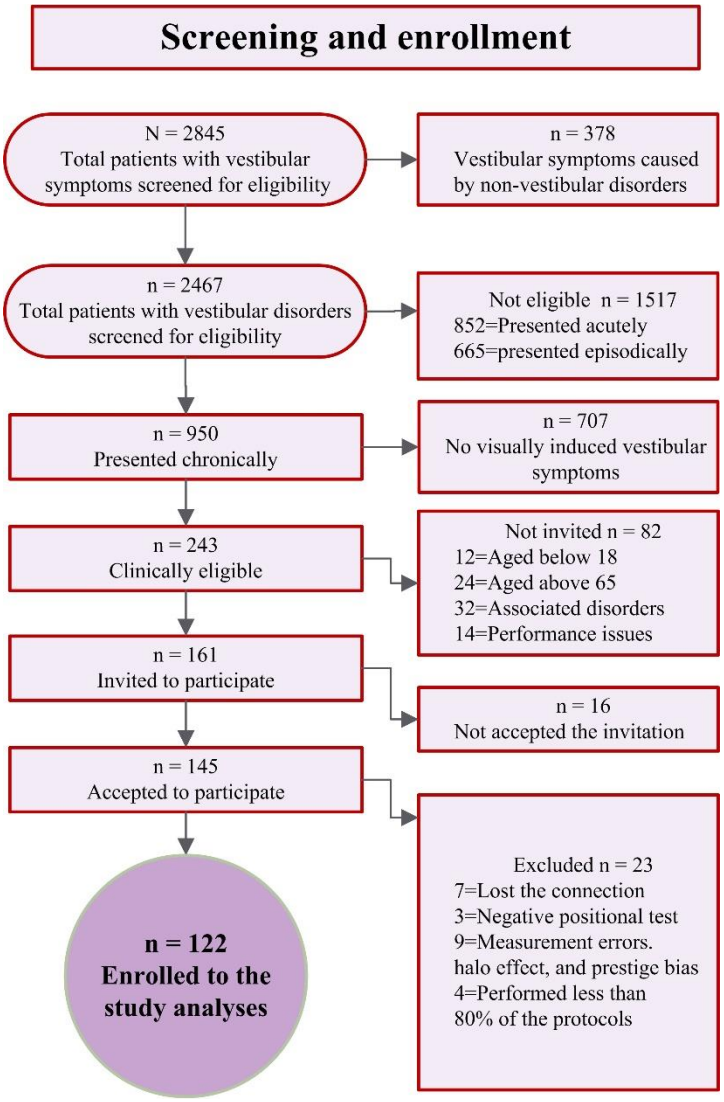

Figure 4.1 Patients' involvement in screening for eligibility and enrollment, in two audio-vestibular tertiary centers during two years of the study.

4.3.3 Design

The design was a controlled prospective study. It was a double blinded interventional trial; that is, nor the author neither the medical staff were aware of enrolment to specific group of interventions. However, the design was converted to short term longitudinal design for the reliability group.

4.3.4 Randomization

Participant who accepted invitation was enrolled and allocated to one of the two treatment protocols based on a simple randomization[114] utilizing a list of random numbers generated by Microsoft excel.

4.3.5 Outcome measures (OMs)

4.3.5.1 Primary OMs

The following three primary OMs were utilized:

4.3.5.1.1 Visual dependency measure (VDM)

Rod-and-Disk program (downloadable online at:

https://www.imperial.ac.uk/department-of-medicine/research/brain-sciences/clinical-translation/neuro-otology/) was utilized to measure the amount of dependency. The content of the program from the computer was displayed through a high definition 32-inch monitor (diagonal length of the screen was 8cm). In a black background, a bright rod (14 cm in length) located in an empty dark central zone of the screen surrounded by numerous randomly-distributed shining dotes occupying the rest of the screen. A well trained operator seated beside the patient controlled the orientation of the rod and

the movement of the surrounding dotes; that is, stationary, clockwise, and counter-clockwise rotations (Appendix 17).

Following the default random setting of the program, responses (rod-tilt) of five trials of each of the following three situations were measured.

4.3.5.1.1.1 In the first situation, we provided the patient with ordinary visual cues; that is, patient seated with a viewing distance of 38cm in front of the screen looking directly to the whole screen (visible screen's frame and surroundings) and the surrounding-dotes were static; however,

4.3.5.1.1.2 in the second situation, we tried to eliminate visual cues as much as possible; that is, the patients were seated at the same viewing distance but looking to the screen through a cone (23cm near the head and 27cm near the screen); so that, to remove all frames from their visual scenes; furthermore, the surrounding-dotes were rotating clockwise.

4.3.5.1.1.3 In the third situation, same as second; nevertheless, the surrounding dotes were rotating counter-clockwise.

The test implemented in a semi-dark room; for each of the aforementioned trials, participants were requested to answer by *no* or *yes* if the rod is not aligned or aligned with their perceived vertical, respectively; that is, subjective visual vertical (SVV).

The visual dependence was calculated by the difference between of the mean of the absolute value (both right and left tilt were treated as positive value) of the rod-tilt in the static SVV and both rotatory situations: dynamic SVV[14, 115].

4.3.5.1.2 Visual Vertigo Analogue Scale (VVAS)

This scale (Appendix 18) was originally adopted from Longridge and his colleagues[116], it is a useful scale for quantifying the visual vertigo[117]; furthermore, guideline has recommended it as an outcome measure in vestibular disorders[118]. It consists of nine environmental visual situations that may induce disorientation. Beneath each of the nine situation a ten-fraction-scale was located, patients were invited to rate the intensity of their perceived dizziness in each experienced situation. Each scale ranged between 0 and 10 to represent no to maximum disorientation, respectively. Patients were instructed to omit any unexperienced situation. The sum of the total responses was divided on numbers of answered responses (VVAS-T).

The tool has not previously been cross-culturally adapted to Kurdish; therefore, we implemented a required focus group sessions[40, 41] and in accordance with the steps recommended by guidelines related to translation and adaptation[33, 39], the contents of the scale were cross-culturally adapted to the central Kurdish dialect (Appendix 19); additionally, in accordance with steps recommended by Kottner and his colleagues[81], its reliability has been tested by comparing VVAS-T of two repeated measures within the duration of one to five days for 43 randomly selected participants.

4.3.5.1.3 CTSIB

The CTSIB (Appendix 8 and 9) was originally developed by Shumway-Cook and Horak[119] to evaluate the role of visual, vestibular, and proprioception on postural stability. It is inexpensive and easy to administer in analytic settings[44]. The tool has excellent reliability[67] and validity[120] while examining adult patients with vestibular disorders. The test assesses the postural stability in six conditions. During conditions 3 and 6, patients are requested to maintain balance while they are wearing visually-

conflicted dome to remove any visual cues; consequently, it can assess visual reliance [119]. The recent study has applied the following details to utilize the CTSIB.

While patients standing with attaching/stocking feet and each palm on the opposite shoulder, they were requested to retain their postural stability for three trials (60 seconds for each trial) in the following six conditions:

4.3.5.1.3.1 Eyes-open, standing on a solid and level ground.

4.3.5.1.3.2 Eyes-closed, standing on a solid and level ground.

4.3.5.1.3.3 Eyes-open, standing on a solid and level ground and wearing a visually-conflicted dome.

4.3.5.1.3.4 Eyes-open, standing on a spongy surface.

4.3.5.1.3.5 Eyes-closed, standing on a spongy surface.

4.3.5.1.3.6 Eyes-open, standing on a spongy surface and wearing a visually-conflicted dome.

In each condition, only the first trial was required if they could complete the total 60 seconds in the first trial. That is, the second and the third trials were only necessary when they could not complete the 60 seconds in the first and second trials, respectively. Furthermore, any trial was also considered to be completed if they could not retain their balance before completion of the total 60 seconds; that is, loss of postural stability, moving foot and/or palm, attempting to find help, and opening eyes in the third and six conditions[44, 121].

The score of each of the aforementioned six conditions was calculated through dividing the sum of seconds in performed trial/s by the number of performed trial/s. In accordance with the objective of the study, we have objectively assessed the visual dependence by calculating the sum of conditions 3 and 6 (CTSIB – S); that is, the score ranges from 0 to 120 seconds to represent maximum to no objective visual dependence,

respectively. However, this range was not in agreement with other four measures in which low score represent good health and vice versa; accordingly, to make accordance, the study recoded this variable through reversing the score; that is, zero represents no and 120 represents maximum dependence.

4.3.5.2 **Secondary OMs**

Beside the aforesaid primary outcome measures, the following two secondary OMs were also used:

4.3.5.2.1 Dizziness handicap inventory (DHI)

DHI (Appendix 1) is a popular PROMs and has been extensively utilized by the researcher and clinicians [(34)]. It can efficiently quantify the impacts of vestibular dysfunctions before and after therapeutic protocols. It was developed by Jacobson and Newman[(21)]. The instrument composed of 25 items divided in to three sub-scales: physical (DHI–P), emotional (DHI–E), and functional (DHI–F) with 7, 9, and 9 items respectively. For each item the patient should select one of three responses (*yes*, *sometimes*, and *no*), with a specific value for each response; that is, 4, 2, and 0 respectively. The limits of the total score start with 0 denoting no impact to end with 100 denoting greatest impact. The psychometric properties of DHI as thoroughly discussed in Chapter 2 has been assessed and validated in to central Kurdish dialect: DHI – CK[(67)]; accordingly, the recent study has utilized DHI-CK (Appendix 5) as one of the OMs.

4.3.5.2.2 Vertigo symptom scale − short form (VSS – SF)

This PROMs (Appendix 10) is specifically designed to assess the frequency of vestibular symptoms. It contains 15 symptoms[(74)], extracted from the long form of Vertigo symptom scale[(22)]. The tool utilizes a five-point responses to measure the frequency, each response with a specific value (*never* = 0, *a few times* = 1, *several times*

= 2, *quite often* = 3, and *very often* = 4). Based on type of symptoms, the instrument divided into two subscales: vestibular and autonomic-anxiety. The total sore range from 0−60 with greater value indicating highest frequency. The VSS – SF was cross-culturally validated to central Kurdish dialect: VSS – SF – CK (Appendix 14)[95].

4.3.6 Rehabilitative intervention home protocols

4.3.6.1 Modified CCE Protocol (MCP)

In accordance with the objective of the study and the physical ability of the participants, we modified the CCE (MCP), that is, in bed exercises were omitted, the protocol was performed either with sitting or standing; furthermore, all eye movements that may involve retinal slip and vestibular adaptation were also omitted. The MCP was consisted of the following exercises:

4.3.6.1.1 While sitting on a chair, repeated bending forward and backward to pick up and put down an object from the ground for 20 times.

4.3.6.1.2 Changing the position from sitting to standing 10 times eyes-open and 10 times eye-closed.

4.3.6.1.3 Throwing a small ball from one hand to another above the level of head.

4.3.6.1.4 Throwing a small ball from one hand to another below right and left knees 10 times for each.

4.3.6.1.5 From sitting to standing, turning around, then sitting, 10 times eyes-open and 10 times eye-closed.

4.3.6.1.6 While the participant moving in a circle around a healthy person to throwing and catch a large ball with that person, 10 times clockwise and 10 times counter-clockwise.

4.3.6.1.7 Straight line walking, 10 steps eyes-open and 10 steps eye-closed.

4.3.6.1.8 Walk up and down along a slope and then a stair, eye-open and eye-closed for each.

4.3.6.1.9 General body movements such as stretching, extension, and flexion.

The required time to perform the protocol was estimated to be 12 to 15 minutes (Appendix 20).

4.3.6.2 **Video Optokinetic-training Protocol (VOP)**

The author has contacted Gabrielle Pierce (Appendix 21), the developer of the optokinetic training videos, and granted her approval to use such videos as VOP.

Accordingly, we made a short continuous video clip of 10:13 minutes duration. The clip was composed of the following six short videos of driving and moving checkerboard extracted from her Youtube channel[20]:

4.3.6.2.1 Driving in Light & Shadows (1:28 minutes).

4.3.6.2.2 Pulsing Checkerboard (3:00 minutes).

4.3.6.2.3 Driving in reverse (2:30 minutes).

4.3.6.2.4 Shifting Direction Checkerboard (1:00 minutes).

4.3.6.2.5 Driving Over a Bridge (0:43 minutes)

4.3.6.2.6 Wave Checkerboard (1:31 minutes).

Per patients' suitability, the clip was prepared αin two forms, a playable compact disc and a file that could be transferred to a portable universal serial bus flash driver. Participants from the trial group were instructed to see the clip while they were sitting in front of a TV screen. They were also instructed to calculate the ideal viewing distance by this equation: 1.5 multiplied by the screen size (diagonal length of the screen)[122].

4.3.6.3 **Utilizations of the protocols and OMs**

The following consecutive steps have been followed:

4.3.6.3.1 For both control and experimental groups, the total scores of primary and secondary OMs have been applied for the first time (baseline) before any protocol; that is VDM1, VVAS1, CTSIB-S1, DHI-CK1, and VSS-SF-CK1 (SF1).

4.3.6.3.2 Then, participants were randomly assigned into two groups, control and experimental; they were instructed to use their home settings to perform their specific protocols.

4.3.6.3.3 All participants (control and experimental groups) were requested to apply the MCP four times a day with at least three hours between each session. However, in case of the experimental group, they were also requested to utilise the VOP immediately after each MCP session. They were advised to complete five weeks then return to clinics for second OMs assessment; that is, VDM2, VVAS2, CTSIB-S2, DHI-CK2, and VSS-SF-CK2 (SF2).

4.3.6.3.4 After second assessment, participants from interventional group were instructed to do usual daily activities without specific protocol; however, those from control group were instructed to apply both protocols, MCP and VOP, for another five weeks. All participants were requested to attend the clinics after another five weeks for the third OMs assessment; that is, VDM3, VVAS3, CTSIB-S3, DHI-CK3, and VSS-SF-CK3 (SF3).

4.3.6.3.5 To examine the homogeneity and randomization the first OMs of both groups were compared. However, to examine the effectiveness of VOP on experimental group the second OMs of both groups were compared. Nevertheless, to examine the effectiveness of

VOP on control group, we compared within-group's repeated measures, that is, the second and third measures of the same (control) group; additionally, the maintenance of the VOP's effect on the experimental group, the study was also compared the second and third measures of the same (experimental) group.

Using phone and on a regular weekly base, the protocols were closely followed up by two well-trained medical staff; moreover, they were also ready to answer any call from the participants and their relatives at any time to reply on queries related to the protocols.

4.3.7 Statistical road-map

The statistical decision and interpretation for all analyses in this study were based on the alpha level of significance (α) of $p < .05$.

4.3.7.1 Sample size and power analysis

A priori sample size was estimated based on the assumption that our intervention would make a medium effect size (0.5) and a mean difference in one direction (one tailed); additionally, the power of statistical analysis was set to 85%, that is, $1–\beta = 0.85$; concerning α, it was set to 5%. Consequently, by utilizing G*Power software[123] we calculated the sample size to be ≥ 118.

4.3.7.2 Initial assessment of the nature and distribution of the data

Before selection of any statistical test, knowledge about the nature and distribution of the data was mandatory; Accordingly, the below steps were followed:

4.3.7.2.1 The pre and post intervention five OMs were investigated for the floor and ceiling effects; the percentage of the lowest and highest scores were expected to be below 15%[53].

4.3.7.2.2 Pairwise exclusion was used for records with missing values.

4.3.7.2.3 Per data's suitability, their distributions (nominal and numeric) were investigated through:

4.3.7.2.4 Eyeball test; that is looking to the histogram, boxplots, and Q-Q (quantile) plot.

4.3.7.2.4.1 Numerical method; that is, absolute Z-score (|Z|) for either skewness and kurtosis of < 1.96[45].

4.3.7.2.4.2 Normality test; that is, non-significant Shapiro-Wilk (SW) test [124].

4.3.7.2.4.3 Homogeneity of variance across groups; investigated through parametric and Median-based Levene's tests[125].

4.3.7.3 **Selection of the statistical designs and tests**

The statistical designs

4.3.7.3.1 Independent-samples design (between-groups), this was used to assess

4.3.7.3.1.1 the randomization and comparability of both group

4.3.7.3.1.2 To examine the effectiveness of the VOP on experimental group; that is, the first and second OMs of both groups would be compared.

4.3.7.3.2 Dependent-samples (paired) design (within-groups), this was used to assess the:

4.3.7.3.2.1 Effect of VOP on control group, we compared within-group's repeated measures, that is, the second and third measures of the control group.

4.3.7.3.2.2 Maintenance of the VOP's effect on the experimental group was also examined when we measured the outcomes after five weeks from cessation of the OKT and compared them with those of the second measures of the experimental group.

4.3.7.4 **Hypotheses:**

Three different hypotheses were stated:

4.3.7.4.1 Homogeneity hypothesis, to ensure homogeneity between the two independent groups, null hypothesis must be retained; accordingly, the following 2-tailed hypothesis was stated:

4.3.7.4.1.1 H_0: the distribution or the score of the baseline variables; that is, nominal and numerical including the first OMs (VDM─1, VVAS─1, CTSIB-S─1, DHI-CK─1, and VSS-SF-CK─1) in both randomly selected groups are equal.

4.3.7.4.1.2 H_A: At least the distribution or the score of one or more of the aforementioned variables are not equal.

4.3.7.4.2 Effectiveness hypothesis (independent-samples), to assure the effectiveness of VOP, null hypothesis must be rejected. Here, the scores' means (μ) or the sum of the ranks ($\sum R$) of the second OMs (VDM─2, VVAS─2, CTSIB-S─2, DHI-CK─2, and VSS-SF-CK─2) of both groups would be analysed. Based on the fact that our

rehabilitative interventions would not deteriorate the health condition in our patients; thus, utilising the second OMs, the study stated the following 1-tailed hypotheses:

4.3.7.4.2.1 H_0: μ or median or $\sum R$ of VOP-group = μ or median or $\sum R$ of MCP-group.

4.3.7.4.2.2 H_A: μ or median or ∑R of VOP-group < μ or median or ∑R of MCP-group.

4.3.7.4.3 Effectiveness and Maintenance hypotheses (dependent-samples), in this case

4.3.7.4.3.1 Effectiveness hypothesis, here, only the OMs of the control group would be compared; that is, the second OMs and the third OMs (VDM─3, VVAS─3, CTSIB-S─3, DHI-CK─3, and VSS-SF-CK─3). To support effectiveness, the one-tailed alternative hypothesis should be accepted; consequently, utilising the second and third OMs of the control group, the following hypotheses were stated:

1) H_0: μ or median or $\sum R$ of third OMs ≥ μ or median or $\sum R$ of second OMs.

2) H_A: μ or median or $\sum R$ of third OMs < μ or median or $\sum R$ of second OMs.

4.3.7.4.4 Maintenance of the VOP's effect hypothesis, to be certain that the effect of VOP remained after five weeks of its cessation. To support the maintenance, null hypothesis should retain; that is, the scores of third OMs must remain equal to or lesser than the second OMs. Accordingly, utilising the second and third OMs of the experimental group, the succeeding 2-tailed hypotheses were stated:

4.3.7.4.4.1 H_0: μ or $\sum R$ of third OMs ≤ μ or $\sum R$ of second OMs.

4.3.7.4.4.2 H_A: μ or $\sum R$ of third OMs > μ or $\sum R$ of second OMs.

Furthermore, the magnitude of effects was also estimated.

4.3.8 The statistical tests

Assessment of randomization, comparability and effectiveness of interventions, would be tested by comparing the relative proportion of nominal and numerical variables to ensure successfulness of allocation and homogeneity of the two groups as well as to delineate the effectiveness of different modalities of treatments.

This was based on the results of the aforementioned initial assessments; consequently, the study has established and followed the below statistical agenda:

4.3.8.1 For nominal data

Such as: gender, occupation, residence, educational level, and clinical diagnosis were tested for homogeneity in both groups:

4.3.8.1.1 Pearson's chi-square test ($X^2_{.05}$), if the variable met the assumption of $X^2_{.05}$; that is,

4.3.8.1.1.1 expected frequency for each cell in contingency table must be at least 5 in 80% of cells.

4.3.8.1.1.2 no one cell can have frequency below 3.

4.3.8.1.1.3 Independency of each observation.

4.3.8.1.2 Fisher's Exact test, if the variable did not meet the aforementioned assumption of $X^2_{.05}$ [126, 127].

4.3.8.2 **For numeric data:**

Such as: age, duration of symptoms, and OMs:

4.3.8.2.1 Between-groups design

4.3.8.2.1.1 Independent Samples t-test to compare the means, in the case of normally distributed and homogeneous variables

4.3.8.2.1.2 Welch's t-test, in the case of normally distributed and non-homogeneous variables[128].

4.3.8.2.1.3 Mann-Whitney U test to compare medians or mean ranks, in the case of non-normally distributed variables [129]; here, the medians would be compared in cases of variables with scores of similar shapes; however, if their shapes were not similar, population mean ranks would be compared[56].

Since our sample size is relatively large (>20), for the purpose of interpretation, the study performed normal approximation of the Mann-Whitney U test; that is, the calculated standardized value (Z_C) was found through the following equations:

First: The U statistics of both group were found; that is U_1 and U_2 through:

$$U_1 = (n_1 \times n_1) + \frac{n_1(n_1+1)}{2} - \sum R_1$$

Equation 4—1 Estimation of U_1 in Mann-Whitney U test

$$U_2 = (n_2 \times n_2) + \frac{n_2(n_2+1)}{2} - \sum R_2$$

Equation 4—2 Estimation of U_2 in Mann-Whitney U test.

Second: The U statistics of the test was identified and it was equal to the smallest value of either U_1 and U_2.

Third: Estimation of standardized value through:

$$Z_C = \frac{U - \frac{n_1 \times n_2}{2}}{\sqrt{\frac{n_1 \times n_2 - (n_1 + n_2 + 1)}{12}}}$$

Equation 4—3 Estimation of calculated Z value in Mann-Whitney U test.

where:

U_1 = U statistic of MCP-group.

U_2 = U statistic of VOP-group.

n_1 = number of observations in MCP-group.

n_2 = number of observations in VOP-group.

$\sum R_1$ = sum of ranks in MCP-group.

$\sum R_2$ = sum of ranks in VOP-group.

U = U statistic of the test.

Z_C = calculated standardised value of the test.

4.3.8.3 Choice of statistical tests for within-groups design

4.3.8.3.1 Paired-samples t-test, in the case of normally distributed variables [130].

4.3.8.3.2 Wilcoxon signed ranked test, to compare population mean ranks, in the cases of non-normally distributed variables and the resultant differences between the two repeated measures were symmetrically distributed; that is, similar shapes and the spreads [131].

4.3.8.3.3 Binomial sign test for two dependent Samples, to estimate the sign of the differences between repeated measures (positive and negative) in order to compare the medians of two series of values of the same outcome measure. This would be used in the cases of non-normally distributed variables and the resultant differences between the repeated measures were not symmetrically distributed; that is, non-similar shapes and the spreads[132].

4.3.8.4 Rejection and acceptance of hypotheses

The alternative hypothesis would be accepted whenever:

4.3.8.4.1 The test statistic (t) exceeded its reciprocal 1-tailed or 2-tailed critical value (CV); that is $p < .05$.

4.3.8.4.2 The absolute value of $Z_C \geq$ than its reciprocal value; the 1-tailed and 2-tailed critical value of the Z_C at .05 α level of significance ($Z_{U.05}$) is 1.65 and 1.96, respectively; consequently, absolute value of $Z_C \geq 1.65$ and 1.96 were considered significant in 1-tailed and 2-tailed test, respectively[129, 133].

4.3.8.5 Test for external reliability of VVAS

The study employed intraclass correlation coefficient (ICC) to test the power of external reliability with referenced values of < 0.5, ≥0.5≤0.75, ≥0.75, ≤0.9, and > 0.9 for poor, moderate, good, and excellent, respectively. In ICC, the equation specific to the following characteristics was selected: two-way mixed effects, mean of k raters, and absolute agreement for model, type, and definition, respectively[51].

4.3.8.6 Assessment of the responsiveness of DHI-CK and VSS-SF-CK

The ability of these two outcomes measures to read changes in health status after treatment were assessed by comparing the means of their pre-treatment scores (first measure) with their post-treatment scores (second measure) considering their standard deviations[134]. Using the MedCalc application[135], the study estimated the magnitude of effect through three parameters; that is, baseline standard deviation, pooled SD, and standardized response mean (SRM)

4.3.8.7 Effect size (ES) calculation and interpretation

The followings are equations used to determine ES based on the design and type of test:

4.3.8.7.1 ES for X^2 (w-index), was calculated through two equations: that is,

$$\emptyset c = \sqrt{\frac{X^2}{n(k-1)}} \quad \text{and} \quad w = \emptyset c \sqrt{k-1}$$

Equation 4—4 Two equations for effect size (w-index) calculation in Chi-square test.

where

Φ_C = Cramer's phi coefficient

X^2 = X^2 value

n = total number of observations

k = the smaller value of either r (row) or c (column) in contingency table

w = the effect size for $X^{2(136)}$.

Moreover, for the magnitude of effect, the study followed Cohen (1988) as w = 0.1—small, w = 0.3—medium, and w = 0.5—large effect sizes[137].

4.3.8.8 **ES for independent samples t-test**

The ES was calculated by determining Cohen's d_S (samples); that is standardized mean difference (this can be extracted from the output of a conducted t test on the standardized values of tested variable); additionally, it can be estimated by this equation:

$$d_S = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(n_1 - 1)\ {SD_1}^2 + (n_2 - 1)\ {SD_2}^2}{n_1 - n_2 - 2}}}$$

Equation 4—5 Estimation of Cohen's d_S (effect size of independent samples t-test)

Where

d_S = effect size

$\bar{X}_1$ = mean of the observations in the first group

$\bar{X}_2$ = mean of the observations in the second group

N = total number of observations

SD = standard deviation

In other words, the numerator is the means difference and the denominator is the pooled standard deviation.

4.3.8.9 **ES for paired-samples t-test**

This was calculated by estimating both Cohen's d_z and Cohen's d_{ave} (average), the former value was calculated directly from the output of the test using one of these two equations:

$$d_z = \frac{M}{SD} \quad \text{or} \quad d_z = \frac{t}{\sqrt{n}}$$

Equation 4—6 Equations to calculate Cohen's d_Z (effect size of dependent samples t-test

Where

M = mean

SD = standard deviation

t = calculated t statistic

n = total number of observations

Nevertheless, for the latter (Cohen's d_{ave}) was calculated using estimates of descriptive statistics through this equation:

$$d_{ave} = \frac{M_{diff}}{\frac{SD_1 + SD_2}{2}}$$

Equation 4—7 Calculation of Cohen d_{ave}.

where

M_{diff} = mean difference between means of both correlated measures.

SD_1 = first standard deviation.

SD_2 = Second standard deviation[138].

4.3.8.10 ES for Mann-Whitney U test

the ES was calculated using this equation:

$$r = \frac{|Z|}{\sqrt{n}}$$

Equation 4—8 Effect size calculation for Mann-Whitney U test

where the

r = effect size

$|Z|$ absolute value of the calculated Z value output in the test[139].

4.3.8.11 ES for Wilcoxon signed ranked test

The latter equation was also used to determine the ES but, *n* was equal to the total number of observations (records) in both pre and post measures[140].

4.3.8.12 ES for binomial sign test,

The ES (Cohen's h) was estimated in two steps:

4.3.8.12.1 Transforming the proportions of both measures (P_1 and P_2) in to new values, named *phi* (Φ); that is, Φ_1 and Φ_2.

4.3.8.12.2 To determine the size of difference between P_1 and P_2 (effect size or Cohen's h), the difference between their reciprocal Φs was calculated[141]; that is,

$$h = |\emptyset_1 - \emptyset_2|$$

Equation 4—9 Calculation of Cohen's h (effect size in binomial sign test)

The value of Φ for any P would be extracted from Table 6.2.2 in Cohen's book; published in 1988: page 183[142].

4.3.8.13 The responsiveness of the DHI-CK and VSS-SF-CK

This was assessed by the estimation of ES by utilising the following three parameters:

4.3.8.13.1 Baseline SD; that is, Glass' Δ.

4.3.8.13.2 Pooled SD; that is, d_S.

4.3.8.13.3 Standardized response mean (SRM)[134, 143].

4.3.8.14 **Interpretation of relevant ES,**

The study followed Cohen's tables of power; that is, the threshold of ES would be interpreted as following:

4.3.8.14.1 For standardised mean difference; that is, d or Δ: 0.2─small, 0.5─medium, 0.8─large, and 1.3─very large[144].

4.3.8.14.2 For correlation; that is, *r*: 0.1─small, 0.3─medium, 0.5─large, and 0.7─very large[145].

4.3.8.15 **Software**

All the analyses were conducted with IBM SPSS Statistics V21 (IBM, Armonk, NY, USA); except, sample size which was calculated by G*Power software[123] and ES which was calculated using Microsoft Excel.

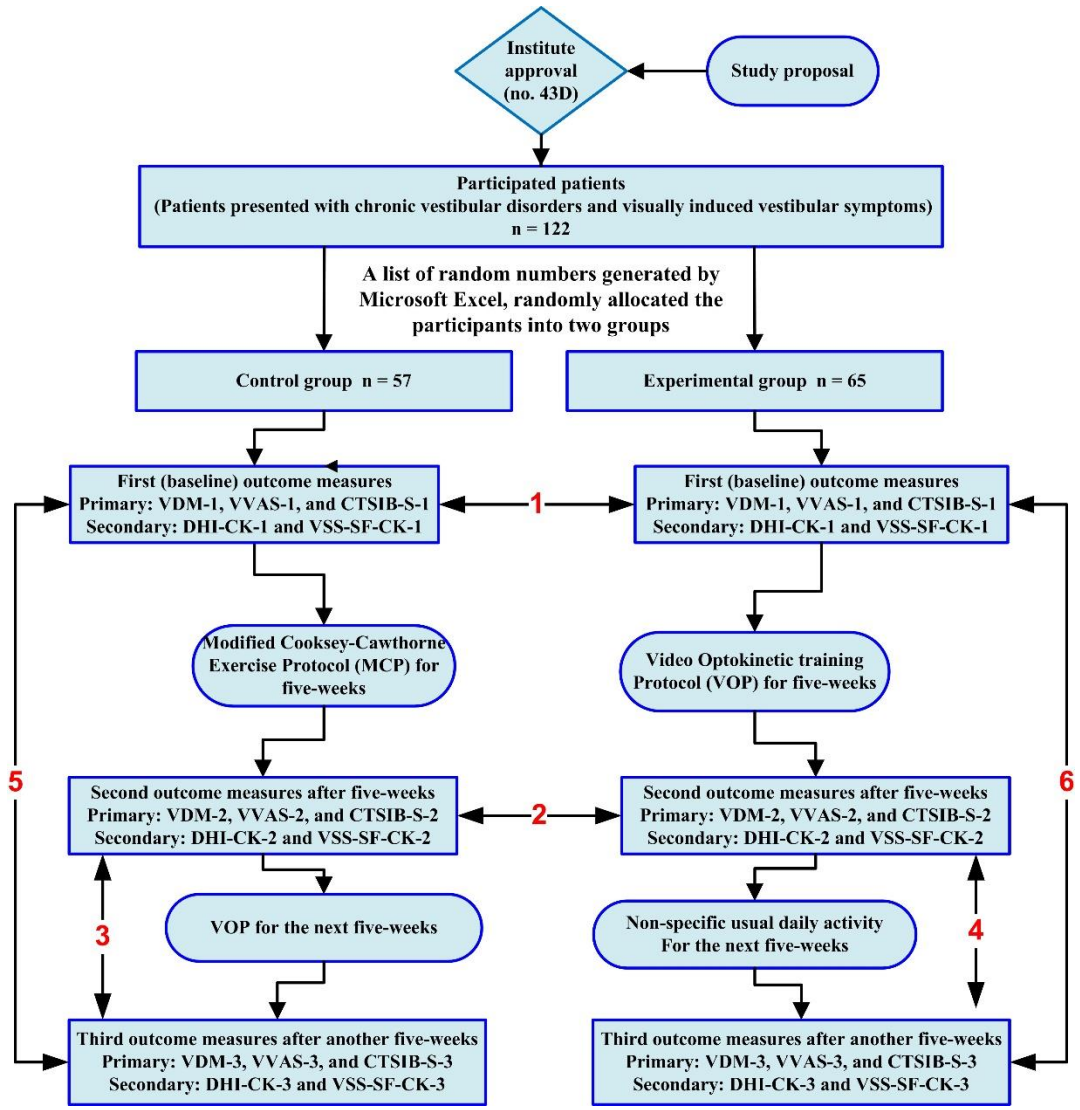

Figure 4.2 The consecutive logic sequence of the study.

Note: Number 1, 2, and 3 beside each outcome measure represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures, respectively.
Abbreviations: VDM, Visual Dependency Measure; VVAS, Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Dizziness Handicap Inventory- Central Kurdish version; VSS-SF-CK, Vertigo Symptom Scale-Short Form-Central Kurdish.

Red numbers in Figure 4.2 represent the following statistical analysis for comparing different outcome measures:

1. Between-groups analysis,
the first outcome measures of both groups were compared to examine the successfulness of the randomization and independency of outcome measures.

2. Between-groups analysis,
the second outcome measures of both groups were compared to examine the effectiveness of VOP on experimental group.

3. Within-groups analysis,
the second and third outcome measures of control group were compared to examine the effectiveness of VOP during the second five weeks.

4. Within-groups analysis,
the second and third outcome measures of experimental group were compared to examine the maintenance effect of VOP after its cessation for five weeks.

5. Within-groups analysis,
to delineate the combined effects of ten-weeks of MCP and five-weeks of VOP on control group after ten weeks.

6. Within-groups analysis,
to delineate the combined effects of five-weeks of MCP and five-weeks of VOP on experimental group after ten weeks.

4.4 Results

4.4.1 Patients screening and enrolment

During the two years of the study, 2845 patients with vestibular symptoms were screened for eligibility. However, only 243 patients were considered to be eligible, that is, patients objectively diagnosed as chronic vestibular disorders and having visually induced vestibular symptoms. Furthermore, inclusion and exclusion criteria as well as refusal to accept invitation have eventually dropped the participants number to 122 (**Figure 4.1**). No significant changes were noticed in computation because of exclusions.

4.4.2 The logic sequence of the study

In a sequential manner, steps implemented in randomization, allocation, employment of OMs in three occasions, rehabilitation's protocols, and statistical approach are shown in **Figure 4.2**.

4.4.3 Demographic and baseline features

Characteristic features of the total enrollees (n = 122) and different groups are demonstrated in **Table 4.1**. In the total sample (n = 122), the women constituted 54.1% (n = 66), the mean, standard deviation, and (range) of age in years and duration of symptoms in months were 41.3 ± 12.1 (47) and 12 ± 18.9 (120), respectively. The majority of the participants 82.8% (n = 101) were resided in Sulaimani Governorate (centre and district). Concerning occupation, 49.2% (n = 60) of patients were government's employees. Furthermore, 47.5% (n = 58) of the participants were either

having no education or graduated from primary schools. Lastly, the chronic vestibular insufficiency (CVI) was the commonest clinical diagnosis 41% (n = 50).

Table 4.1 Demographic characteristics of the participants.

	Total Patients			Control group			Experimental group			Reliability subgroup of VVAS[a]		
	n = 122			n = 57			n = 65			n = 43		
	Mean	**SD**	**R**	**Mean**	**SD**	**R**	**Mean**	**SD**	**R**	**Mean**	**SD**	**R**
Age (year)	41.3	± 12.1	47	42.7	± 12	47	40	± 12	47	42.7	± 12.7	47
Duration (month)	12	± 18.9	119	11.4	±18.4	119	12.4	19.4	119	10.5	± 15.7	65
	n	**%**		**n**	**%**		**n**	**%**		**n**	**%**	
Women	66	54.1		43	59.6		32	49.2		23	53.5	
Residence in relation with Sulaimani Governorate												
Center	51	41.8		24	42.1		27	41.5		17	39.5	
District	50	41		25	43.9		25	38.5		20	46.5	
Outside	21	17		8	14		13	20		6	14	
Occupation												
House wife	21	17.2		11	19.3		10	15.4		10	23.3	
Teacher	24	19.7		13	22.8		11	16.9		9	20.9	
Employee	36	29.5		18	31.6		18	27.7		10	23.3	
Student	11	9		5	8.8		6	9.2		4	9.3	
Not working	14	11.5		5	8.8		9	13.8		4	9.3	
Worker	16	13.1		5	8.8		11	16.9		6	14	
Education												
No or Primary[b]	58	47.5		25	43.9		33	50.8		20	46.5	
Secondary[b]	40	32.8		18	31.6		22	33.8		11	25.6	
Graduate & higher	24	19.7		14	24.6		10	15.4		12	27.9	
Clinical diagnosis												
CPV	16	13.1		6	10.5		10	15.4				
CVI	50	41		24	42.1		26	40				
NVN	35	28.7		19	33.3		16	24.6				
VM	21	17.2		8	14		13	20				

Note: [a]The study has only tested the reliability of VVAS because it was the only subjective PROMs that has not been validated in Kurdish; [b]Primary and secondary schools; All the vestibular disorders were chronic and unilateral.
Abbreviations: VVAS, Visual Vertigo Analogue Scale; SD, Standard Deviation; R, Range; CPV, Chronic Positional Vertigo; CVI, Chronic Vestibular Insufficiency; NVN, Non Compensated Vestibular Neuritis; VM, Vestibular Migraine; PROMs, Patient Reported Outcome Measures.

4.4.4 Data screening, baseline nominal and numeric variables

4.4.4.1 Nominal Variables

4.4.4.1.1 The Z-score of skewness and kurtosis

Data related to skewness, kurtosis, and percentage of observed cell count of each variable are shown in **Table 2**; it revealed that, gender and level of education are associated with different degree of skewness and kurtosis; however, the rest of variables were normally distributed.

4.4.4.1.2 Randomization and homogeneity of the groups

$X^2_{.05}$ for homogeneity has tested the nominal variables, the succeeding results are demonstrated in the aforementioned table

4.4.4.1.2.1 Based on gender, the percentage of patients in both groups did not differ, $X^2_{.05}$ (1, n = 122) = 1.33, $p > .05$, $w = 0.1$.

4.4.4.1.2.2 Based on residence, participants were mixed homogenously in both groups, $X^2_{.05}$ (2, n = 122) = 0.85, $p > .05$, $w = 0.08$.

4.4.4.1.2.3 Based on occupation, no significant differences were found between groups, $X^2_{.05}$ (5, n = 122) = 3.19, $p > .05$, $w = 0.16$.

4.4.4.1.2.4 Based on educational level, different categories were similarly distributed between groups, $X^2_{.05}$ (2, n = 122) = 1.7, $p > .05$, $w = 0.12$.

4.4.4.1.2.5 Based on clinical diagnosis, patients in both groups were belong to similar disorders. $X^2_{.05}$ (3, n = 122) = 2.01, $p > .05$, $w = 0.13$.

4.4.4.2 **The numeric variables**

4.4.4.2.1 Baseline (first) OMs

4.4.4.2.1.1 The floor and ceiling effects.

They were investigated through descriptive statistics; their lowest and highest scores were far below 15% [53].

4.4.4.2.1.2 The Z-score of skewness and kurtosis.

These data along with Shapiro-Wilk tests revealed that, three of these variables; that is, duration of symptoms, VDM-1, and CTSIB-S-1 have exhibited different degrees of skewness and kurtosis; nevertheless, all other variables were normally distributed.

4.4.4.2.1.3 Homogeneity of variances.

Levene's test revealed that the variances of baseline numeric variables between groups are homogenous. Accordingly, appropriate tests were appointed for necessary analyses **(Table 4.3)**.

4.4.4.3 **Second and third OMs**

The total patients and both groups have exhibited the following features

4.4.4.3.1 The floor and ceiling effects

The descriptive statistics demonstrated that the floor and ceiling effects of all variables are located within normal range.

Furthermore, **Table 4.4** exhibited the ensuing results

4.4.4.3.2 The Z-score of skewness and kurtosis

Results of Shapiro-Wilk tests and Z-scores have shown that all these variables are not normally distributed and all of them have demonstrated different ranges of skewness and kurtosis.

4.4.4.3.3 Homogeneity of variances

Because of non-normality, the equality of variances was examined by Median-based Levene's test. It revealed that in the second OMs, VDM-2, CTSIB-S-2, and DHI-CK-2 are non-homogeneous; however, for the third OMs, only VDM-3 was non-homogeneous.

Consequently, non-parametric tests (documented in the **Table 4.5**) were implemented for all analyses.

4.4.4.4 **Normality curves and features of all OMs (first, second, and third) and in three occasions**

Figure 4.3 revealed the distribution and normality curve of all OMs in three different times. Data related to the center, spread (interquartile range), variance, shape, and unusual features of the aforementioned variables and occasions are demonstrated numerically and graphically, respectively in, **Table 4.5** and **Figure 4.4**. The second and third OMs have contained eight outliers (Figure 4.4); nevertheless, no any variable was associated with potential outlier

Table 4.2 Skewness, kurtosis, and outcomes of cross-tabulation in contingency tables of nominal.

	MCP group (Control)				Total patients					VOP group (Experimental)			
	n = 57				n = 122					n = 65			
	Z-Skew[a]	Z-Kurt[a]	Co[b]	%[c]	*v*[d]	X^2_{CV}[e]	X^2_O[f]	*p*-value[g]	*w*-index[h]	Co[b]	%[c]	Z-Skew[a]	Z-Kurt[a]
Gender													
Male	1.28	-3.1	23	18.9	1	5.02	1.33	.25	.10	33	27	-0.11	-3.52
Female			34	27.9						32	26.2		
Residence in relation with Sulaimani Governorate													
Center	1.43	-1.37	24	19.7	2	7.38	0.85	.66	.083	27	22.1	1.30	-1.98
District			25	20.5						25	20.5		
Outside			8	6.6						13	10.7		
Occupation													
House wife	1.94	-0.63	11	9	5	12.83	3.19	.67	.16	10	8.2	0.70	-1.96
Teacher			13	10.7						11	9		
Employee			18	14.8						18	14.8		
Student			5	4.1						6	4.9		
Not working			5	4.1						9	7.4		
Worker			5	4.1						11	9		
Education													
No or Primary[i]	1.18	-2.21	25	20.5	2	7.37	1.7	.44	.12	33	27	2.27	-1.45
Secondary[i]			18	14.8						22	18		
Graduate & higher			14	11.5						10	8.2		
Clinical diagnosis													
CPV	0.45	-0.97	6	4.6	3	9.34	2.01	.57	.13	10	8.2	0.58	-1.67
CVI			24	19.7						26	21.3		
NVN			19	15.6						16	13.1		
VM			8	6.6						13	10.7		

Note: [a]Z-scores of skewness and kurtosis, they were estimated by dividing skew or kurtosis values on their corresponding standard errors; [b]No any cell has frequency less than 5, that is, assumptions of chi-square were met; [c]Percentage within total patients; [d]The degree of freedom calculated through *(c–1)×(r–1)* where *c* is number of column and *r* is number of row in contingency table; [e]Two-tailed chi-square critical value; [f]Observed chi-square value higher than critical value would reject the null hypothesis; [g]Value less than 5% is significant; [h]Magnitude of effect derived from Cramer's phi coefficient; [i]Primary and secondary schools.
Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; C_O, Observed cell count; X^2_{CV}, Critical value of Pearson chi-square; X^2_O, Obtained value of Pearson chi-square (statistical result of in this study); *df*, Degree of freedom; CPV, Chronic Positional Vertigo; CVI, Chronic Vestibular Insufficiency; NVN, Non Compensated Vestibular Neuritis; VM, Vestibular Migraine; PROMs, Patient Reported Outcome Measures.

Table 4.3 Baseline distribution and homogeneity of the numeric data in total patients and different groups.

	MCP group (Control)			Total patients				VOP group (Experimental)			
	n = 57			n = 122				n = 65			
	Z-Skewness[a]	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**Z-Skewness[a]**	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**Levene's test[b]**	**Z-Skewness[a]**	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**Independent test[c]**
Age (year)	0.41	-0.90	.072	0.76	-1.30	.021	.97	0.70	-0.87	.288	t
Duration (month)	14.04	38.24	.000	18.03	42.91	.000	.54	12.33	28.04	.000	U
VDM─1	2.29	-0.21	.007	2.29	-0.96	.002	.36	1.01	-1.02	.014	U
VVAS─1	-0.11	-1.31	.052	-0.49	-1.95	.003	.93	-0.60	-1.41	.063	t
CTSIB-S─1	1.31	-1.78	.002	2.29	-1.99	.002	.12	1.69	-1.32	.001	U
HDI-CK─1	0.68	-0.29	.352	1.32	-0.95	.069	.68	0.98	-1.09	.213	t
VSS-SF-CK─1	0.90	-1.11	.143	0.63	-2.11	.017	.10	0.02	-1.80	.061	t

Note: [a]Z-scores of skewness and kurtosis, they were estimated by dividing skew and kurtosis values by their corresponding standard errors; [b]Test of homogeneity of variance among groups; [c]Statistical tests selected based on the homogeneity test and the distribution of both groups; Number 1 beside each outcome measure represents the first (baseline) outcome measures, that is, they were measured before any interventions.

Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK-, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

Table 4.4 Distribution and homogeneity of the second and third outcome measures in total patients and different groups.

	MCP group (Control)				Total patients					VOP group (Experimental)					
	n	**Z-Skewness[a]**	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**n**	**Z-Skewness[a]**	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**Median-based Levene's test[b]**	**n**	**Z-Skewness[a]**	**Z-Kurtosis[a]**	**Shapiro-Wilk test**	**Independent test[c]**	**Dependent test[c]**
VDM–2	53	2.5	-0.1	.002	114	4.4	1.9	.000	.014	61	1.3	-1.2	.023	M[de]	S[fg]
VDM–3	52	2.2	0.1	.019	112	3.3	1.2	.001	.037	60	1.1	-0.5	.171		
VVAS–2	53	-0.9	-0.8	.033	112	0.2	-1.1	.041	.192	59	0.5	-0.1	.401	U[hg]	W[ie]
VVAS–3	51	2.3	1.0	.046	111	2.1	0.8	.008	.381	60	-0.4	-1.9	.019		
CTSIB-S–2	56	1.3	-1.8	.001	117	3.6	-1.0	.000	.014	61	-3.8	1.5	.000	U[hg]	S[fg]
CTSIB-S–3	53	3.8	3.0	.000	112	6.1	6.4	.000	.843	59	-3.4	3.2	.002		
HDI-CK–2	57	1.1	-1.1	.044	121	2.4	-0.8	.001	.021	64	1.6	-0.9	.009	U[hg]	S[fg]
HDI-CK–3	54	2.2	0.2	.011	114	2.8	-0.5	.000	.834	60	1.9	-0.6	.003		
VSS-SF-CK–2	56	1.7	-0.8	.007	119	3.5	-0.2	.000	.736	63	3.5	1.2	.000	M[de]	W[ie]
VSS-SF-CK–3	55	2.2	1.0	.016	115	3.3	1.7	.000	.251	60	2.4	1.4	.012		

Note: [a]Z-scores of skewness and kurtosis, they were estimated by dividing skew and kurtosis values by their corresponding standard errors; [b]Test of homogeneity of variance among groups; [c]Statistical tests selected based on the Median-based Levene's test and the distribution of both groups; [d]Medians were compared by Median test of independent samples; [e]Utilized when distributions and the variances among groups, respectively, were non-normal and homogeneous, that is, non-significant Median-based Levene's test; [f]Positive and negative differences were

compared by Binomial sign's test for two dependent-samples; [g]Utilized when distributions and the variances among groups, respectively, were non-normal and non-homogeneous, that is, significant Median-based Levene's test; [h]Mean ranks were compared by default Mann-Whitney U test; [i]Positive and negative ranks were compared by Wilcoxon dependent-samples signed-ranks test for dependent samples; Number 2 and 3 beside each outcome measure, respectively, represent the second (five-weeks after interventions) and third (ten-weeks after interventions) outcome measures.

Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; M, Median test of independent samples; S, Binomial sign's test for two dependent-samples; U, Mann-Whitney U test; W, Wilcoxon dependent-samples signed-ranks test;VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

Table 4.5 Distributions and features of the data set related to five outcome measures.

	MCP group (Control)					VOP group (Experimental)				
	Center (median)	**IRQ**	**Variance**	**Shape**	**Outlier**	**Center (median)**	**IRQ**	**Variance**	**Shape**	**Outlier**
VDM–1	5.6	8.2	25.3	Right skewed	None	6.8	6.1	20.4	Right skewed	None
VDM–2	4.5	7.3	20.5	Right skewed	None	3.4	4	8.4	Right skewed	None
VDM–3	2.9	3.4	5.7	Right skewed	None	2.6	2.3	2.9	Right skewed	None
VVAS–1	3.8	3	2.6	Left skewed	None	3.8	3	2.7	Symmetric	None
VVAS–2	3.3	2.3	2.4	Left skewed	None	2.4	1.6	1.7	Left skewed	Yes
VVAS–3	2	2	1.9	Symmetric	yes	2	1.2	1.9	Symmetric	None
CTSIB-S–1	35	57	1082	Right skewed	None	30	52	783	Right skewed	None
CTSIB-S–2	32	56	934	Right skewed	None	21	28	532	Right skewed	Yes
CTSIB-S–3	22	30	514	Right skewed	Yes	19	20	228	Symmetric	Yes
HDI-CK–1	40	24	277	Symmetric	None	40	32	429	Symmetric	None
HDI-CK–2	18	17	133	Right skewed	None	14	10	77	Right skewed	None
HDI-CK–3	12	10	63	Right skewed	Yes	13	10	70	Right skewed	Yes
VSS-SF-CK–1	17	12	53	Symmetric	None	18	14	75	Symmetric	None
VSS-SF-CK–2	7	6	16	Left skewed	None	5	6	16	Right skewed	Yes
VSS-SF-CK–3	5	4	8	Left skewed	Yes	5	5	11	Left skewed	Yes

Note: Number 1, 2, and 3 beside each outcome measure represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures, respectively.
Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

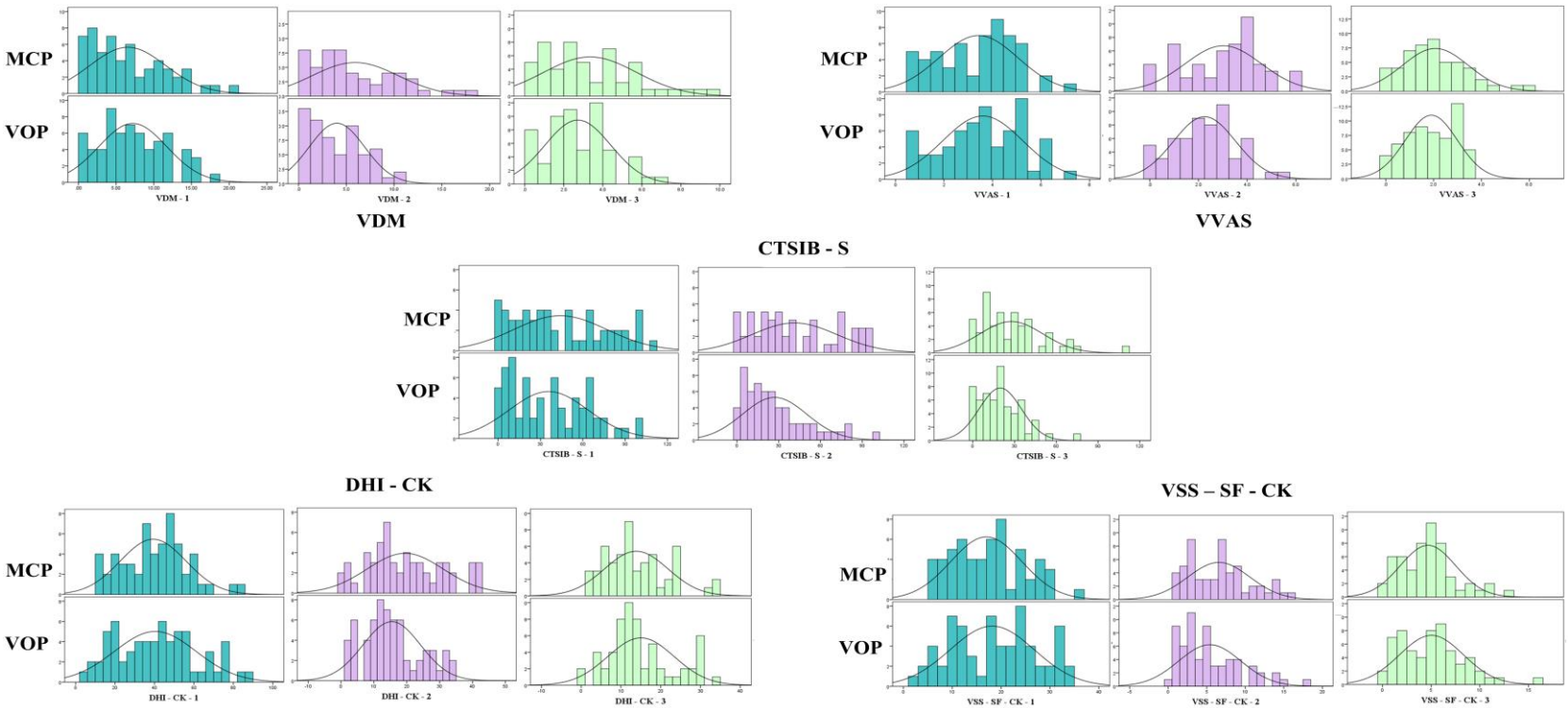

Figure 4.3 Distribution and normality curve of the scores of five outcome measures in two groups measured in three different occasions

Note: Each color represents an occasion (the time where the measure was applied); Number 1, 2, and 3 beside each outcome measure represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures, respectively

Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

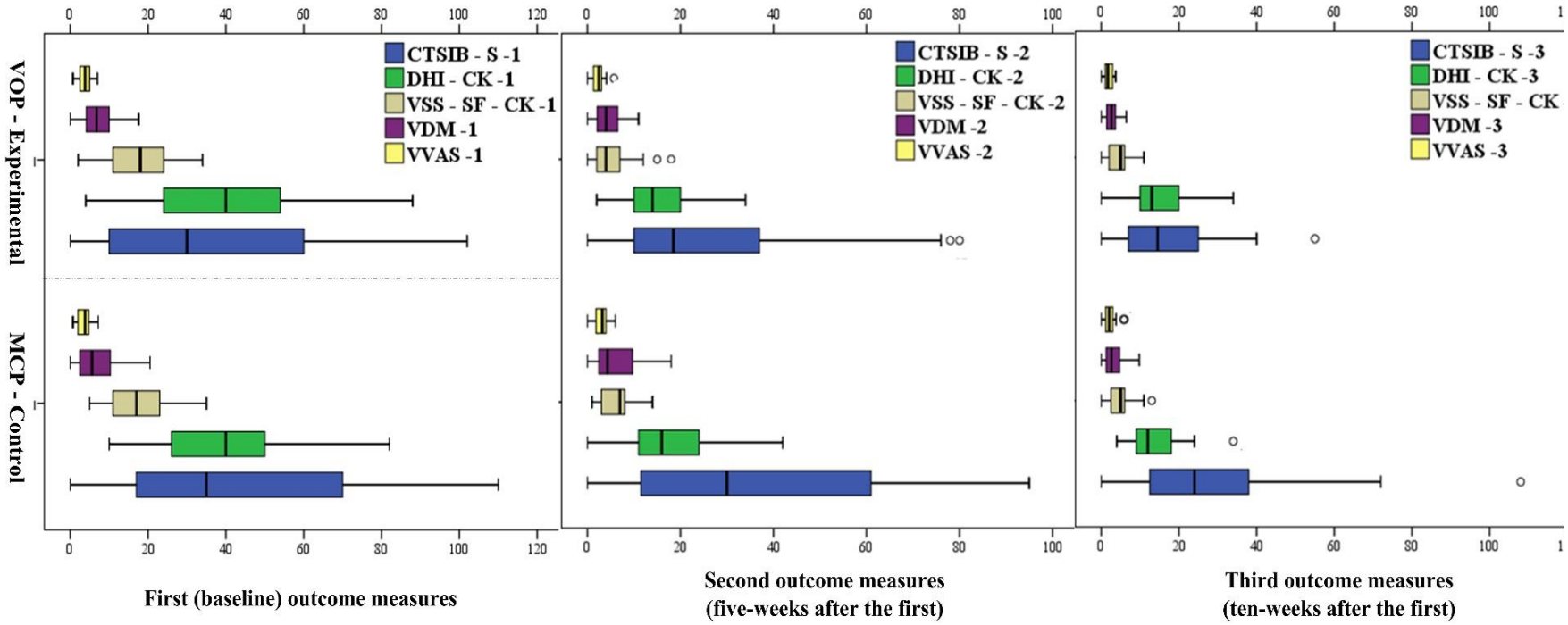

Figure 4.4 Box and whisker plots representing the center, spread, shape, and un-usual features in five outcome measures in two groups, measured in three different occasions

Note: Each color represents an outcome measure; Number 1, 2, and 3 beside each outcome measure represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures, respectively; Circles beside box and whisker plot represent outlier cases.
Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

4.4.4.5 **Randomization and homogeneity of the two groups**

Based on skewness, kurtosis, and equal variance assumption, independent samples t or U tests has tested the baseline numeric variables to examine the successfulness of randomization; that is, none of them is dependent on specific group; **Table 4.6** reveals the following results:

4.4.4.5.1 No significant effect was found for age, t-test revealed that the scores were similar in MCP-group (M = 42.72, SD = 12.04) and VOP-group (M = 40.05, SD = 12.06), t(120) = 1.22, p > .05, d_S = 0.22.

4.4.4.5.2 Concerning the duration (month) of vestibular symptoms, the 57 patients in the MCP-group (Mdn = 6) and the 65 patients in the VOP-group (Mdn = 5.5), demonstrated no significant difference; T_C = 1832 (Z = 0.11), p = .92, ES = -0.01.

4.4.4.5.3 The scores of VDM in MCP-group (Mdn = 5.6) and VOP-group (Mdn = 6.8) were similar; T_C = 1.613 (Z = -1.05), p = .29, ES = -0.10.

4.4.4.5.4 Results indicate that differences between scores of VVAS-T in both groups are not significant; MCP-group (M = 2.61, SD = 1.43) and VOP-group (M = 1.31, SD = 1.15), t(120) = -.59, p > .05, d_S = -0.11.

4.4.4.5.5 The total scores of the objective test; that is, CTSIB-S, in both groups did not differ; T_C = 0.123 (Z = -1.33), p = .18, ES = -0.12.

4.4.4.5.6 Based on the scores of DHI-CK-T, both groups showed similar impacts; MCP-group (M = 19.51, SD = 11.57) and VOP-group (M = 15.75, SD = 9.1), t(120) = -.31, p > .05, d_S = -0.06.

4.4.4.5.7 Both groups revealed similar scores when the severity of symptoms was rated through VSS-SF-CK-T; MCP-group (M = 8.97,

SD = 5.68) and VOP-group (M = 11.11, SD = 8.9), t(120) = -.83, p > .05, d_S = -0.15.

Table 4.6 Independency of the baseline numeric variables among two groups using independent-samples tests.

	MCP group (Control)		Total patients (Independent-samples tests)						VOP group (Experimental)	
	n = 57		n = 122						n = 65	
	Mean (Mdn) [MR]	SD	Test	df[a]	T_{CV} (Z_{CV})	T_C (Z_C)	p-value $\alpha = .05$[b]	ES	SD	Mean (Mdn) [MR]
Age (year)	42.72	12.04	t	120	1.98	1.22	.22	.22	12.06	40.05
Duration (month)	11.42 (6) [61.14]	18.44	U	Not applicable	1.96	1837 (.11)	.92	-0.01	19.40	12.42 (5.5) [61.82]
VDM─1	6.55 (5.6) [57.91]	5.03	M	Not applicable	1.96	1.613 (1.05)	.28	-0.10	4.51	7.21 (6.8) [64.65]
VVAS─1	3.42	1.63	t	120	1.98	-.59	.56	-0.11	1.65	3.60
CTSIB-S─1	44.04 (35) [66.05]	32.90	M	Not applicable	1.96	.123 (-1.33)	.87	-0.12	27.99	35.78 (30) [57.51]
HDI-CK─1	39.33	16.65	t	120	1.98	-.31	.76	-0.06	20.72	40.40
VSS-SF-CK─1	16.96	7.28	t	120	1.98	-.83	.41	-0.15	8.64	18.17

Note: [a]Degree of freedom in independent samples t-test is equal to $(n_1+n_2) – 2$; [b]The high p-values (> .05) in the tests denote that none of the variables is dependent on any group; Number 1 beside each outcome measure represent the first (baseline) outcome measures, that is, they were measured before any interventions.

Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; Mdn, Median; MR, Mean rank; SD, Standard Deviation; df, degree of freedom; T_{CV}, 2-tailed critical value of t, extracted from t-distribution table based on sample size and degree of freedom; Z_{CV}, 2-tailed Z critical value (tabulated-z) based on normal approximation; T_C, calculated test-statistic; Z_C, calculated standardized Z value; ES, Effect size; U, default Mann-Whitney U test; VDM, Visual Dependence Measure; M, Median test of independent samples; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

4.4.4.6 Dependency of the baseline OMs based on gender

Based on gender, the sample (n = 122) was classified into two groups, (female = 66). The 2-tailed independent samples tests of the numeric baseline OMs, revealed that the mean of VSS-SF-CK is significantly higher in female; otherwise, no any other OMs were dependent on gender (**Table 4.7).**

4.4.4.7 External reliability consistency of VVAS

The average measure of ICC in test-retest reliability of the VVAS-T was 0.77, confirming good external reliability consistency.

4.4.4.8 Effectiveness of VOP on experimental (VOP) group

Based on equality of variances, medians and mean ranks of the five OMs in second occasions in both groups were compared by median independent samples test or Mann-Whitney U test. **Table 4.8** and **Figure 4.5** presented the following results:

4.4.4.8.1 The scores' mean ranks of the VDM-2 in both groups was significantly different, with low score in favour with VOP-group; T_C = 1259 (Z = 2.03), p = .21, ES = -0.19.

4.4.4.8.2 When the severity of symptoms was scored by VVAS-2, the medians of the VOP-group was significantly lower; T_C = 8.1 (Z = 3.08), p = .004, ES = -0.29.

4.4.4.8.3 Mann-Whitney U test revealed that the mean ranks for the scores of CTSIB-S-2 is significantly lower in VOP-group; T_C = 1259 (Z = 2.45), p = .007, ES = -0.23.

4.4.4.8.4 Results indicate that differences between scores' mean ranks DHI-CK-2 in both groups are significantly lesser in VOP-group; T_C = 1470 (Z = 1.85), p = .034, ES = 0.17.

4.4.4.8.5 The scores' medians of VSS-SF-CK-2 was significantly declined in VOP-group; $T_C = 5.08$ ($Z = 1.77$), $p = .02$, ES = -0.16.

Table 4.7 Independency of the baseline numeric variables based on gender using independent-samples tests.

	Female		Total patients (Independent-samples tests)						Male	
	n = 66		n = 122						n = 56	
	Mean (Mdn) [MR]	SD	Test	df[a]	T_{CV} (Z_{CV})	T_C (Z_C)	p-value $\alpha = .05$[b]	ES	SD	Mean (Mdn) [MR]
Age (year)	40.71	11.63	t	120	1.98	-.58	.57	-0.11	12.65	41.98
Duratinth)	12.92 (6) [63.44]	18.66	U	Not applicable	1.96	1720 (-.66)	.51	0.06	19.28	10.81 (5) [59.21]
VDM–1	7.36 (6.7) [64.56]	5.13	M	Not applicable	1.96	2.11 (-1.04)	.20	0.09	4.25	6.37 (5.8) [57.89]
VVAS–1	3.35	1.66	t	120	1.98	-1.19	.24	-0.22	1.60	3.71
CTSIB-S–1	40.73 (33) [62.47]	31.42	M	Not applicable	1.96	.028 (-.329)	.99	0.03	29.69	38.38 (34) [60.36]
HDI-CK–1	42.64	17.02	t	120	1.98	1.75	.82	0.32	20.50	36.68
VSS-SF-CK–1	20.08	7.56	t	120	1.98	3.90	.000	0.72	7.61	14.70

Note: [a]Degree of freedom in independent samples t-test is equal to $(n_1+n_2) - 2$; [b]The high p-values (> .05) in the tests denote that only VSS-SF-CK is dependent on female group; Number 1 beside each outcome measure represent the first (baseline) outcome measures, that is, they were measured before any interventions.

Abbreviations: Mdn, Median; MR, Mean rank; SD, Standard Deviation; df, degree of freedom; T_{CV}, 2-tailed critical value of t, extracted from t-distribution table based on sample size and degree of freedom; Z_{CV}, 2-tailed Z critical value (tabulated-z) based on normal approximation; T_C, calculated test-statistic; Z_C, calculated standardized Z value; ES, Effect size; U, default Mann-Whitney U test; VDM, Visual Dependence Measure; M, Median test of independent samples; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

Table 4.8 Five-weeks' effectiveness of video optokinetic training protocol on experimental group.

	MCP group (Control)			Total patients (Independent-samples tests)					VOP group (Experimental)		
	Mean (Mdn) [MR]	SD	n	Conducted test	Z_{CV}	T_C (Z_C)	*p*-value $\alpha = .05^a$	ES	Mean (Mdn) [MR]	SD	n
VDM─2	5.93 (4.5) [64.25]	4.53	53	U	1.65	1259 (2.03)	.021	0.190	4.01 (3.4) [51.64]	2.91	61
VVAS─2	3.02 (3.3) [66.46]	1.56	53	M	1.65	8.1 (3.08)	.004	0.291	2.25 (2.4) [47.55]	1.27	59
CTSIB-S─2	41.27 (32) [67.02]	30.57	56	U	1.65	1259 (2.45)	.007	0.226	27.05 (21) [51.64]	23.08	61
HDI-CK─2	19.51 (18) [67.22]	11.56	57	U	1.65	1470 (1.85)	.034	0.168	15.44 (14) [55.46]	8.75	64
VSS-SF-CK─2	6.57 (7) [65.90]	4.02	56	M	1.65	5.08 (1.77)	.020	0.162	5.40 (5) [54.75]	4.04	63

Note: [a]Low p-values (> .05) in the tests denote that there are significant differences in the distribution of outcome measures among groups; Number 2 beside each outcome measure represent the second outcome measures, that is, they were measured five weeks after interventions.

Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; Mdn, Median; MR, Mean rank; SD, Standard Deviation; Z_{CV}, 1-tailed Z critical value (tabulated-z) based on normal approximation; Z_C, calculated standardized Z value; T_C, calculated test-statistic; Z_{CV}, Z critical value; T_C, Calculated test-statistic; Z_C, Calculated Z value; ES, Effect size; VDM, Visual Dependence Measure; U, default Mann-Whitney U test; VVAS, Total score of Visual Vertigo Analogue Scale; M, Median test of independent samples; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

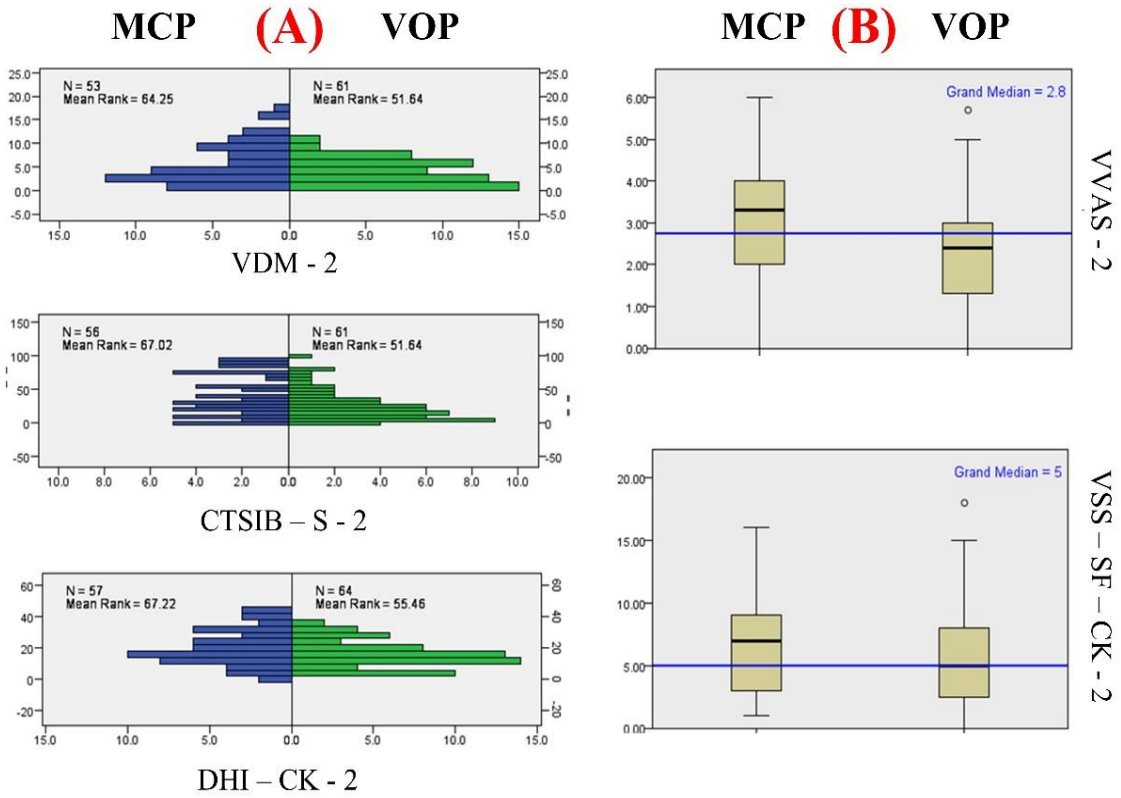

Figure 4.5 Non-parametric independent-samples tests, showing comparison between the medians and mean ranks of the five outcome measures in two groups five weeks after interventions; (A), Independent samples Mann-Whitney test; (B), Independent samples Median test.

Note: the scores of all five subjective measures in VOP-group is lower than the MCP-group (low score means good health); Tests were selected based on the scores' shapes of specific measure in both group; Number 2 beside each outcome measure represent the second outcome measures, that is, they were measured five weeks after interventions.
Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version

The following four consecutive assessments were examined by non-parametric dependent-samples tests; the included results are presented in **Figure 4.6** and **Table 4.9.**

4.4.4.9 **Effectiveness of VOP on control (MCP) group (1-tailed dependent-samples tests)**

The scores of the OMs in the second and third occasions were compared in control group; based on the nature of data, Binomial sign's test for two dependent-samples and Wilcoxon dependent-samples signed-ranks test produced the succeeding results in the following OMs (**Table 9-a**):

4.4.4.9.1 The scores of VDM-3 (Mdn = 2.9) was lesser that the scores of VDM-2 (Mdn = 4.5); $Z = 4.67$, $p < .05$, $r = 1.55$.

4.4.4.9.2 The scores of VVAS-3 (Mdn = 2) was lesser that the scores of VVAS-2 (Mdn = 3.3); $Z = 4.13$, $p < .05$, $r = 0.42$.

4.4.4.9.3 The scores of CTSIB-S-3 (Mdn = 22) was lesser that the scores of CTSIB-S-2 (Mdn = 32); $Z = 4.2$, $p < .05$, $r = 1.93$.

4.4.4.9.4 The scores of DHI-CK-3 (Mdn = 12) was lesser that the scores of DHI-CK-2 (Mdn = 18); $Z = 5.69$, $p < .005$, $r = 2.30$.

4.4.4.9.5 The scores of VSS-SF-CK-3 (Mdn = 5) was lesser that the scores of VSS-SF-CK-2 (Mdn = 7); $Z = 4.88$, $p < .05$, $r = 0.47$.

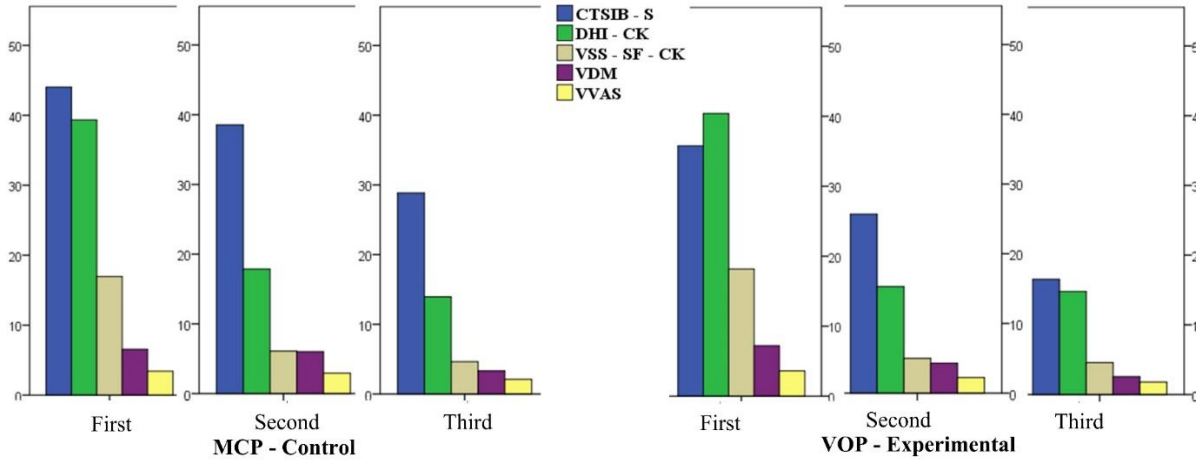

Figure 4.6 Decline in the score of five outcome measures in three consecutive occasions in two groups

Note: Each color represents an outcome measure;
Abbreviations: MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; VOP, Video Optokinetic-training Protocol; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

4.4.4.10 **Maintenance of VOP's effect on experimental (VOP) group (2-tailed dependent-samples tests)**

In this situation, the scores of all OMs for the experimental group in second and third occasions were compared. Similarly, the nature of the data in both occasions governed the selection of either Binomial sign's test for two dependent-samples or Wilcoxon dependent-samples signed-ranks test; accordingly, for the below results were generated to the corresponding OMs (**Table 9-b**):

4.4.4.10.1 Subtracting the scores of VDM-3 from VDM-2, revealed higher +differences; $Z = 3.51$, $p < .05$, $r = 1.047$.

4.4.4.10.2 Subtracting the scores of VVAS-3 from VVAS-2, revealed higher +ranks; $Z = 2.24$, $p < .05$, $r = 2.13$.

4.4.4.10.3 Subtracting the scores of CTSIB-S-3 from CTSIB-S-2, revealed higher +differences; $Z = 2.96$, $p < .05$, $r = 0.867$.

4.4.4.10.4 Subtracting the scores of DHI-CK-3 from DHI-CK-2, revealed higher +differences; $Z = 0.67$, $p < .05$, $r = 0.20$.

4.4.4.10.5 Subtracting the scores of VSS-SF-CK-3 from VSS-SF-CK-2, revealed higher +ranks; $Z = 1.81$, $p < .05$, $r = 0.17$.

Table 4.9 Non-parametric dependent-samples tests, demonstrating the effectiveness of the OTP on control group, maintenance of OTP's effect in experimental group, and Combined effect of MCP and OTP on experimental group after ten weeks.

Related Variables		Test	Total n	+ Ranks or differences[a] (Proportion) [Φ_1]	─ Ranks or differences[b] (Proportion) [Φ_2]	Ties[c]	Z_{CV}	Z_C	T_C	$P \leq .05$	ES[d]
a - Effectiveness of VOP on control group (1-tailed dependent-samples tests)											
VDM─2	**VDM─3**	S[e]	48	40 (.851) [2.346]	7 (.148) [.795]	1	1.65	4.67	41	.000	1.551
VVAS─2	**VVAS─3**	W[f]	49	36	11	2	1.65	4.13	954	.000	.417
CTSIB-S─2	**CTSIB-S─3**	S[e]	52	41(.804) [2.214]	10 (.196) [.284]	1	1.65	4.2	41	.000	1.930
HDI-CK─2	**HDI-CK─3**	S[e]	54	47 (.904) [2.498]	5 (.096) [.200]	2	1.65	5.69	47	.000	2.298
VSS-SF-CK─2	**VSS-SF-CK─3**	W[f]	54	43	10	1	1.65	4.88	1262	.000	.470
b - Maintenance of VOP's effect on experimental group (2-tailed dependent-samples tests)											
VDM─2	**VDM─3**	S[e]	56	41 (.745) [2.094]	14 (.254) [1.047]	1	1.96	3.51	41	.000	1.047
VVAS─2	**VVAS─3**	W[f]	55	34	16	5	1.96	2.24	869	.025	.213
CTSIB-S─2	**CTSIB-S─3**	S[e]	55	39 (.709) [2.004]	16 (.291) [1.137]	0	1.96	2.96	39	.003	.867
HDI-CK─2	**HDI-CK─3**	S[e]	59	31 (.554) [1.671]	25 (.446) [1.471]	3	1.96	.668	31	.504	.200
VSS-SF-CK─2	**VSS-SF-CK─3**	W[f]	58	28	26	4	1.96	1.81	951	.892	.168
c - Combined effects of five-weeks of MCP and five-weeks of VOP on experimental group after ten weeks (1-tailed dependent-samples tests)											
VDM─1	**VDM─3**	W[f]	60	54	5	1	1,65	6.265	1715	.000	.572
VVAS─1	**VVAS─3**	W[f]	60	56	3	1	1,65	6.123	1696	.000	.559

CTSIB-S─1	**CTSIB-S─3**	W[f]	59	40	18	1	1.65	3.903	1359	.000	.359
HDI-CK─1	**HDI-CK─3**	W[f]	60	56	2	2	1,65	6,583	1705	.000	.601
VSS-SF-CK─1	**VSS-SF-CK─3**	W[f]	60	53	6	1	1.65	6.294	1718	.000	.575
d - Combined effects of ten-weeks of MCP and five-weeks of VOP on control group after ten weeks (1-tailed dependent-samples tests)											
VDM─1	**VDM─3**	W[f]	52	41	10	1	1,65	5.10	1207	.000	0.50
VVAS─1	**VVAS─3**	W[f]	51	44	7	0	1,65	5.41	1239	.000	0.54
CTSIB-S─1	**CTSIB-S─3**	W[f]	53	39	11	3	1.65	4.65	1119	.000	0.45
HDI-CK─1	**HDI-CK─3**	W[f]	54	53	1	0	1,65	6.27	1470	.000	0.60
VSS-SF-CK─1	**VSS-SF-CK─3**	W[f]	55	54	1	0	1.65	6.41	1535	.000	0.61

Note: [a]Related observations where the second OMs > third OMs; [b]Related observations where the second OMs < third OMs; [c]Related observations where the second OMs = third OMs; [d]To estimate effect size (h) in Binomial sign's test for two dependent-samples, proportions and Φs were calculated; Number 1, 2, and 3 beside each outcome measure, respectively, represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures; [e]Binomial sign's test for two dependent-samples (utilized when Median-based Levene's test was significant); [f]Wilcoxon dependent-samples signed-ranks test (utilized when Median-based Levene's test was non-significant).

Abbreviations: VOP, Video Optokinetic-training Protocol; Φ, Phi; Z_{CV}, 1-tailed and 2-tailed Z critical value (tabulated-z) based on normal approximation; Z_C, calculated standardized Z value; T_C, calculated test-statistic; VDM, Visual Dependence Measure; VVAS, Total score of Visual Vertigo Analogue Scale; CTSIB-S, Sum of conditions 3 and 6 in Clinical Test of Sensory Interaction on Balance; DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version; MCP, Modified Cooksey ─ Cawthorne Exercise Protocol; OMs, Outcome Measures.

4.4.4.11 **Combined effects of five weeks of MCP and VOP on experimental (VOP) group after ten weeks (1-tailed dependent-samples tests)**

When the scores of the OMs in the third occasions were subtracted from their corresponding's' in the first occasions (baseline), the below results were generated from Wilcoxon dependent-samples signed-ranks test which revealed higher +ranks in all outcome measure; moreover, their Z_C were much higher than their corresponding Z_{CV} (Table 9-c)

4.4.4.11.1 VDM, $Z = 6.27$, $p < .05$, $r = 0.57$.
4.4.4.11.2 VVAS, $Z = 6.12$, $p < .05$, $r = 0.56$.
4.4.4.11.3 CTSIB-S, $Z = 3.90$, $p < .05$, $r = 0.36$.
4.4.4.11.4 DHI-CK, $Z = 6.58$, $p < .05$, $r = 0.60$.
4.4.4.11.5 VVS-SF-CK, $Z = 6.30$, $p < .05$, $r = 0.58$.

4.4.4.12 **Combined effects of ten-weeks of MCP and five-weeks of VOP on control group after ten weeks (1-tailed dependent-samples tests)**

Comparison between first and third OMs of the control group identify the effects of ten-weeks MCP and five-weeks VOP on the control group. Accordingly, Wilcoxon dependent-samples signed-ranks test revealed higher +ranks in all outcome measure; moreover, their Z_C were much higher than their corresponding Z_{CV} (Table 9-d)

4.4.4.12.1 VDM, $Z = 5.10$, $p < .05$, $r = 0.50$.
4.4.4.12.2 VVAS, $Z = 5.41$, $p < .05$, $r = 0.54$.
4.4.4.12.3 CTSIB-S, $Z = 4.65$, $p < .05$, $r = 0.45$.

4.4.4.12.4 DHI-CK, $Z = 6.27$, $p < .05$, $r = 0.60$.

4.4.4.12.5 VVS-SF-CK, $Z = 6.41$, $p < .05$, $r = 0.61$.

4.4.4.13 **Responsiveness of DHI-CK and VSS-SF-CK after five-weeks and ten-weeks intervals**

Both Validated PROMs were examined for responsiveness through comparing three repeated measures; that is responsiveness after five-weeks and ten-weeks. **Table 4.10** and **Figure 4.7** contains the detail of these assessments. The values of three resultant related parameters were: ES by baseline SD = 1.62, ES by pooled SD = 2.14, and SRM, 0.47.

Table 4.10 Responsiveness of two translated patient reported outcome measures after five-weeks and ten-weeks intervals.

	DHI-CK-1 DHI=CK-2		**DHI-CK-1 DHI=CK-3**		**VSS-SF-CK-1 VSS-SF-CK-2**		**VSS-SF-CK-1 VSS-SF-CK-3**	
	Five-weeks interval		Ten-weeks interval		Five-weeks interval		Ten-weeks interval	
	DHI-CK-1	DHI=CK-2	DHI=CK-1	DHI=CK-3	VSS-SF-CK-1	VSS-SF-CK-2	VSS-SF-CK-1	VSS-SF-CK-3
Sample size	121	121	114	114	119	119	115	115
Arithmetic mean	39.60	17.36	39.91	14.47	17.71	5.95	17,68	4.86
Variance	375	107	344	66.43	64.39	16.45	62.29	9.45
SD	18.64	10.33	18.57	8.15	8.02	4.06	7.89	3.07
Mean difference	22.25		25.44		11.74		12.81	
Pooled SD	15.07		14.34		6.36		5.99	
SD of paired differences	47.75		53.75		25.18		27.15	
ES by baseline SD (95% CI)	1.19 (1.02 to 1.36)		1.37 (1.18 to 1.58)		1.47 (1.21 to 1.69)		1.62 (1.37 to 1.87)	
ES by pooled SD (95% CI)	1.48 (1.25 to 1.67)		1.77 (1.53 to 2.02)		1.85 (1.51 to 2.13)		2.14 (1.81 to 1.87)	
SRM (95% CI)	.47 (.45 to .47)		.47 (.46 to .48)		.47 (.45 to .48)		.47 (.46 to .48)	

Note: Responsiveness were estimated using three parameters, that is, baseline SD, pooled SD, and SRM; the magnitude of effects is directly proportional with elapsed time.

Abbreviations: DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version; SD, Standard Deviation; ES, Effect Size; CI, Confidence Interval; SRM, Standardized Response Mean; Number 1, 2, and 3 beside each outcome measure, respectively, represent the first (before interventions), the second (five-weeks after interventions) and third (ten-weeks after interventions) outcome measures.

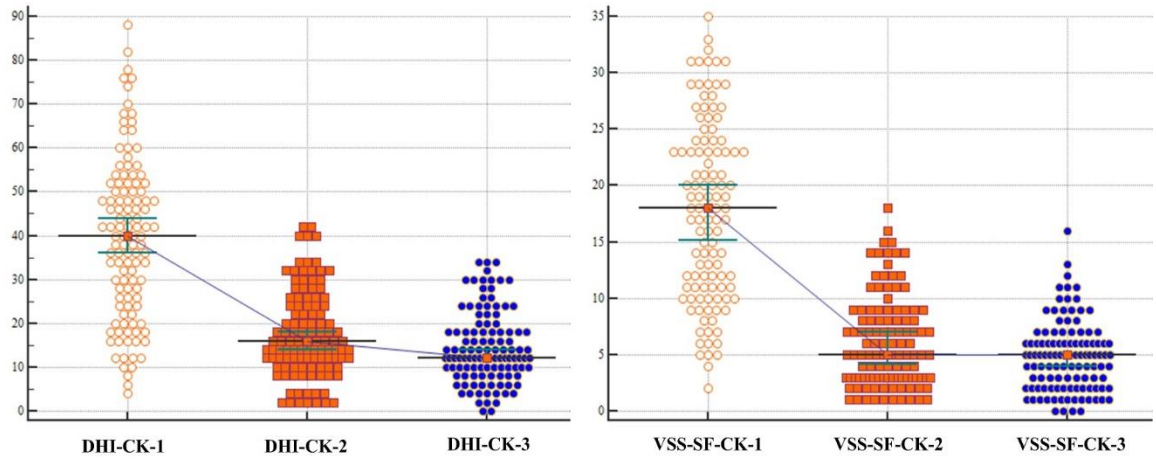

Figure 4.7 Responsiveness of two translated patient reported outcome measures during five and ten weeks.

Note: Each color represents an occasion; Markers represents the medians; Total patients was included in the analysis, that is, both control and experimental groups; Number 1, 2, and 3 beside each outcome measure, respectively, represent the first (before interventions), second (five-weeks after interventions), and third (ten-weeks after interventions) outcome measures.
Abbreviations: DHI-CK, Total score of Dizziness Handicap Inventory-Central Kurdish version; VSS-SF-CK, Total score of Vertigo Symptom Scale-Short Form-Central Kurdish version.

4.5 Discussion

Optokinetic-training or stimulation in the treatment of patients with chronic vestibular disorders is not a new entity[17]. Various approaches have previously been utilized to enhance optokinetic stimulation thereby reducing the symptoms and enhancing the stability. Among these, clinicians and researchers have used computerized stochastic visual stimulation[146], projection of bright rotatory spots from optokinetic planetarium[147], random circles with different color on a rotatory optokinetic disks[148], and immersive virtual reality[149]. Authors of the aforementioned works have concluded that their optokinetic interventions lessened symptoms and raised postural controls in their patients.

Nevertheless, most of these approaches were provided by high-tech equipment that is, it cannot easily be accessed in most of the clinics. Accordingly, researchers have proposed a low-tech approach that can be easily applied in home environment; that is, visual stimulation through recorded videos from high-tech facilities or DVD containing busy screen savers[18, 111].

However, when “video optokinetic” was used as a keyword for online search in Cochrane Ear, Nose, and Throat, Cochrane Library, and PubMed (MeSH), we found one article authored by Manso and his colleagues[106], in which, they used digital video disc (DVD) contained eleven exercises for optokinetic stimulation; however, it did not contain videos of driving activities. Consequently, to our knowledge, articles related to home-based video optokinetic-training in chronic vestibular disorders have not previously been reported, at least in Iraq.

The initial challenge that have faced the present study was the sample. The study enrolled its participants within a duration of two years, from two major audio-vestibular

tertiary clinics that cover most of the Sulaimani governorate, Iraq; additionally, these centers regularly receive patients from primary and secondary health care institutions. Enrollments witnessed a meticulous filtration to include only participants from target population; that is, chronic unilateral peripheral vestibular disorders having visually induced symptoms of vestibular origin and positive positional test, thereby it reduced the size but a representative sample. The next challenge was close observation of our participants to perform their protocols in the best possible way and to attend their subsequent visits; however, frequent phone contact of the interviewers with the participants and their relative have assisted to overcome this challenge. The last but not the least, was documentation of subjective OMs, genuine responses from the patients were necessary by avoiding halo (over and under generalization of the responses) effect and lack of interest (haphazard selection of responses without clinical base); nevertheless, this was solved by providing comfortable relaxed setting and regular interviewers' assistance.

Apart from VVAS, the validity of the subjective OMs was previously tested in Kurdish; appropriately, based on regulated guidelines, the tool was cross-culturally adapted and its external reliability was assessed which revealed good test-retest external consistency reliability.

The work has examined the successfulness of randomization; results confirmed that both randomly allocated groups, MCP-control and VOP-experimental, were similar and derived from the same population; because, none of the nominal neither numeric baseline variables were significantly related to any group. Moreover, this similarity was also nearly achieved when the effect of gender on the aforementioned OMs was assessed; however, the frequency of vestibular symptoms (VSS-SF-CK) was significantly higher in female group. Properly, these results confirm that the processes of enrolment and allocation were efficient.

4.5.1 **Effectiveness of VOP**

Effectiveness of vestibular rehabilitation has been established; even non-customized protocol reduces impacts and symptomatology. Accordingly, we realized that CCE would promote clinical improvement in control group; nevertheless, it was unethical to leave the control group without specific treatment. Consequently, to delineate the pure effect of VOP, both groups have received CCE; yet, after modification, that is, omitting the eyes exercises (MCP).

The present trial has examined the instant (the second OMs, were measured immediately after five-weeks from the beginning of VOP) influences of five-weeks-VOP on experimental group (Tables 8). Appropriately, it was concluded that, in comparison with control group, receiving VOP for five-weeks significantly (statistically) decreases the scores in both primary and secondary OMs; that is, it reduced visually induced subjective vestibular symptoms (VDM and VVAS) and enhanced stability in visually conflicted environments (CTSIB-S). Moreover, the protocol minimized the physical, emotional, and functional impacts of vestibular disorders (DHI-CK). Further, the frequencies of both core-vestibular and their concomitant autonomic-anxiety symptoms in these patients have also been diminished (VSS-SF-CK). This conclusion has also been further verified when the study examined the influence of VOP on control group (Table 9-a).

Consequently, this trial has reproved the already established concept of: exposure to conflicted environments will efficiently promote vestibular adaptation. This phenomenon was clearly observed by Vitte and his colleagues, when they noticed improvement in optokinetic parameters and decreased sway in vestibular patients after repeated optokinetic stimulation[17]. Additionally, these findings were also consistent with Manso and his colleagues[106], when they concluded that their DVD optokinetic

exercises have reduced dizziness, improved postural control, and enhanced quality of life.

Moreover, the trial has also measured the outcomes of VOP-experimental group to assessed the perpetuation (maintenance) of VOP's influence after five-weeks from its stoppage (the third OMs, were measured after five-weeks from the termination of VOP); relevantly, it was deduced from the results that the promising influences that were appeared in the second OMs on both DHI-CK and VSS-SF-CK were remained; better yet, the situation was more optimistic, since the subjective (VDM and VVAS) and objective (CTSIB-S) visual dependency have witnessed another significant reduction (Table 9-b). That is to say, the symptoms and stability maintained with the same favorable level as the second OMs and even better.

It can be concluded from these results that, the third OMs are the actual and overall measurement of the influences; expressly, the third OMs was taken in a time where the patients have the opportunity to test the overall influences through practicing their daily activities within five-weeks duration after the protocol; in contrary, the second OMs was taken immediately after the protocol; that is, less opportunity to test the influence of the protocol via practicing the daily activities. Additionally, the concept of actuality of the third OMs has been further verified when we noticed the medium and large magnitude of effects (ES) when the study appraised the effectiveness of VOP on control group (Table 9-a, ES > 0.3) and combined effects of MCP and VOP on experimental group (Table 9-c, ES > 0.3).

Tables 8 and 9 display the significant difference between and within groups ($p < .05$); however, these differences are only statistical; It is the ES that could tell us how much large the difference is? Correspondingly, it can be inferred from the estimated ES in aforesaid tables that the calculated ES after five-weeks from the beginning of the VOP which measure the magnitude of VOP's effect alone are small (Table 8, independent

samples, ES > 0.3). Nonetheless, the magnitude of effects enlarged when the combined effects of both VOP and MCP on experimental group was calculated through paired-samples tests; accordingly, we can infer that combined MCP and VOP for five-weeks is associated with larger effect than VOP alone (Table 9-c, dependent samples, ES > 0.3). Lastly, additional evaluation related to the amount of MCP was done on control group; it was noticed that increasing the amount of MCP from five-weeks to ten-weeks did not further enlarged the ES; that is, ES of five-week MCP (Table 9-c) was nearly similar to the ES in ten-weeks MCP (Table 9-d).

4.5.2 Responsiveness of DHI-CK and VSS-SF-CK

This trial revealed that both DHI-CK and VSS-SF-CK are responsive PROMs; after elapsing of five-weeks, their scores have witnessed substantial changes; moreover, these changes were much higher when their scores were measured after ten-weeks; this can be confirmed through the large and consecutive larger values of ESs in three related parameters after elapsing five and ten weeks (Table 10). Besides, in all pre and post-protocols OMs, both PROMs did not show floor and ceiling effects. Although both PROMs have extensively been cross-culturally validated to Kurdish in chapter 1 and 2; however, these results further reinforce their validation.

4.5.3 Strength and limitation

4.5.3.1 Strength

4.5.3.1.1 the sample, participants were selected based on restricted criteria, so that, the sample represent the target population as much as possible.

4.5.3.1.2 The OMs, all OMs were carefully selected, so that, they measure what they intend to measure.

4.5.3.1.3 Statistical analyses, the trial is associated with appropriate extensive statistical analyses; that is, each test was appointed based on the distribution and nature of the data.

4.5.3.2 **Limitation**

4.5.3.2.1 Observation of participants, because the protocols were home-based, we could not closely observe the participants about the quality and quantity of the received protocols.

4.5.3.2.2 Response selection in OMs, response selections were challenging; lack of interest and prompting to haphazard selections were noticed; thus, interviewers were closely observed and regularly assisted the participants to ensure genuine measure.

4.5.3.2.3 Because of ethical consideration and lack of time, longer term effect (beyond ten weeks) of these interventions was not assessed.

4.6 Conclusion and recommendation

In patients with unilateral chronic vestibular disorders and visually induced vestibular symptoms:

Five-weeks VOP has reduced visually induced vestibular symptoms; further, it increased stability in visually conflicted environments.

Combined MCP and VOP for five-weeks was associated with higher reduction in symptoms and greater stability than VOP alone.

Then, VOP alone and/or combined with MCP will diminish visual dependency and promote stability in visually conflicted environments; Accordingly, it is recommended to use these protocols in aforementioned patients.

Lastly, the scores of both cross-culturally validated DHI-CK and VSS-SF-CK were responsive to consecutive changes in health status caused by successive treatments; further, in these repeated measures, they were free from floor and ceiling effects.

4.7 Availability of data and materials

The data set and the supplementary materials supporting the findings of this study are available from the author on request.

Chapter 5 General discussion

5.1 Cross-cultural validation of DHI-CK and VSS-SF-CK

Cross-culturally validated PROMs are extremely important in vestibular specialty; regrettably, to the best of our knowledge, before this, in Kurdish, there were no any validated vestibular PROMs capable to measure the consequences of such a demanding disorders and to elicit the successive changes in health status after treatments.

Fortunately, according to regulated guidelines, the dissertation has utilized two cross-sectional studies and efficiently cross-culturally validated two significant vestibular PROMs to Kurdish central dialect; that is, DHI-CK and VSS-SF-CK.

The dissertation involved the translation and cross-cultural adaptation of two vestibular disorders scales into Kurdish. That is, DHI-CK, that measure the physical, emotional, and functional impacts of vestibular disorders and VSS-SF-CK, which measures both vestibular symptoms and their associated autonomic-anxiety symptoms.

Furthermore, both cross-culturally adapted PROMs have been subjected to reliability tests to assure their external consistencies which revealed good to excellent reliabilities; moreover, Cronbach's alpha has test their internal consistencies which demonstrated good to excellent external and internal consistency reliabilities. Factor analysis has also tested the internal structures. Eventually, we concluded from required assessments that both tools are reliable, validated, and responsive PROMs that can be used by Kurdish medical community to measure and quantify the impacts of vestibular disorders and their core and other related symptoms in pre and post-treatment protocols.

5.2 Effectiveness of VOP

Then, after we acquired the above two significant tools, we implemented a randomized double-blinded controlled interventional trial to verify the effectiveness of VOP in patients with chronic UPVD who complain from dizziness, vertigo, and/or unsteadiness in visually conflicted areas.

Throughout two years of the work, recruitments taken place in two well-equipped tertiary audio-vestibular centers located on the center of Sulaimani governorate that cover a major proportion of the city and its district regions and receive all type of patients that could be seen in primary, secondary, and tertiary health care institutions.

Based on a simple randomization through a list of random numbers generated by Microsoft excel. Participants were randomly allocated to two different groups, MCP alone and combined MCP and VOP. The trial has utilized five related OMs, three primary; that is, VDM, VVAS, and CTSIB and two secondary; that is DHI-CK and VSS-SF-CK.

Extensive necessary statistical analyses revealed effectiveness of VOP alone in treating the participants; nevertheless, the effect of combined MCP and VOP was much larger.

5.3 Contribution to the literature

We believe that these three works make a significant contribution to the literature because, to the best of our knowledge:

Both PROMs were not previously being translated into the target language. Additionally, the study comprehensively addressed a controversial statistical approach for ordinal data in Likert-type items, which do not assume normality, and considered possible differences between parametric and distribution-free tests, and whether one is

more appropriate and robust than the other. Additionally, VOP has not previously been applied as home-based treatment to vestibular patients in Kurdish speaking population.

5.4 Ethics

The three works were carried out in congruence with Helsinki's deceleration (2008) related to ethical principles that must be followed during involvement of humans in medical researches. Patients who acquired the inclusion criteria to participate. Those who accepted the invitations have signed an informed written consent.

Chapter 6 References, appendixes, Kurdish abstracts, and Arabic abstracts

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6.2 Appendixes

Appendix 1. Dizziness Handicap Inventory the original English version.

Dizziness Handicap Inventory			
Items	Yes	Sometimes	No
P1. Does looking up increase your problem?			
E2. Because of your problem, do you feel frustrated?			
F3. Because of your problem, do you restrict your travel for business or recreation?			
P4. Does walking down the aisle of a supermarket increase your problems?			
F5. Because of your problem, do you have difficulty getting into or out of bed?			
F6. Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties?			
F7. Because of your problem, do you have difficulty reading?			
P8. Does performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away) increase your problems?			
E9. Because of your problem, are you afraid to leave your home without having without having someone accompany you?			
E10. Because of your problem have you been embarrassed in front of others?			
P11. Do quick movements of your head increase your problem?			
F12. Because of your problem, do you avoid heights?			
P13. Does turning over in bed increase your problem?			
F14. Because of your problem, is it difficult for you to do strenuous homework or yard work?			
E15. Because of your problem, are you afraid people may think you are intoxicated?			
F16. Because of your problem, is it difficult for you to go for a walk by yourself?			
P17. Does walking down a sidewalk increase your problem?			
E18.Because of your problem, is it difficult for you to concentrate?			
F19. Because of your problem, is it difficult for you to walk around your house in the dark?			
E20. Because of your problem, are you afraid to stay home alone?			
E21. Because of your problem, do you feel handicapped?			
E22. Has the problem placed stress on your relationships with members of your family or friends?			
E23. Because of your problem, are you depressed?			
F24. Does your problem interfere with your job or household responsibilities?			
P25. Does bending over increase your problem?			

Appendix 2. Email shows permission for Kurdish cross-cultural validation of the DHI from the original developer.

Dr. Sherko Zmnako <sherko.zmnako@gmail.com> Tue, Mar 17, 2015, 11:46 PM

to gary.jacobson

Dear professor **Jacobson, Gary P**
good day
it is my pleasure to email you.
I would like to take a permission from you as a developer of DHI dizziness handicap inventory to translate DHI to my mother language (Kurdish language) so that we can serve our patients in a better way.
I am waiting for your respected reply.

Thanks and best regards
--

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Jacobson, Gary P <gary.jacobson@vanderbilt.edu> Tue, Mar 17, 2015, 11:56 PM

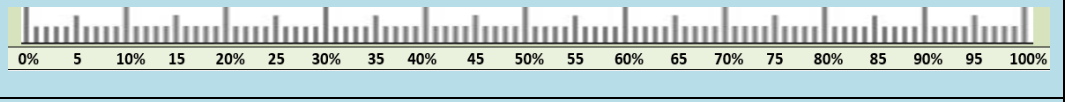
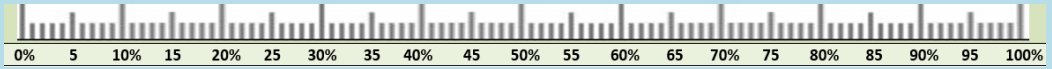
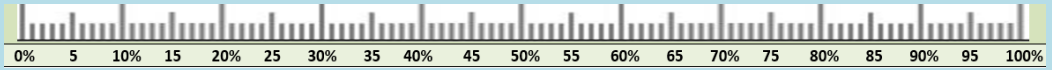
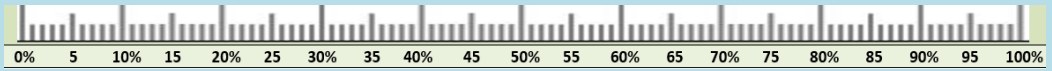
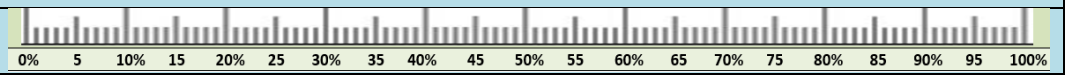
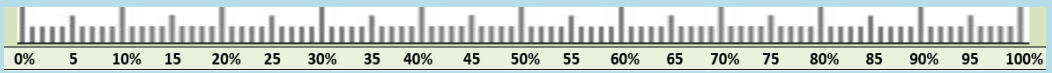
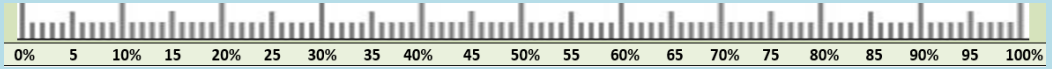
to me

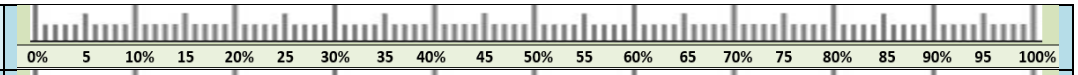
Please proceed. I only ask that you reference the original work in any materials that emanate from this project.

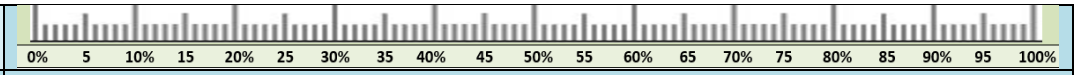
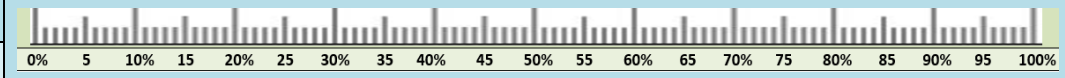
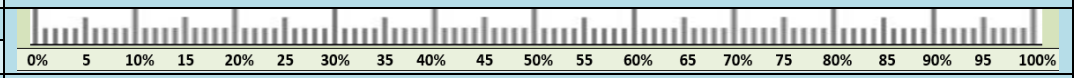
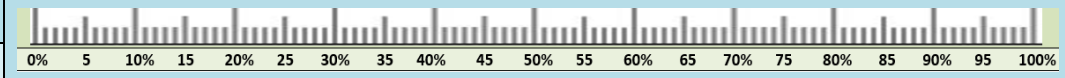
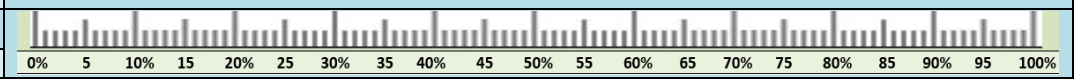
Appendix 3. Specific rating scale for content and face validation of Dizziness Handicap Inventory into central Kurdish dialect.

وەلامی ئەم (٢٥) پرسیارەی خوارەوە، بە کاردەهێنرێ وەک پێوەرێک بۆ دیاریکردنی ڕادەی پەککەوتن کە دروست دەبێت بەهۆی کێشەی گێژبونەوە، بۆ هەر پرسیارێک تەنها سێ وەڵام هەیە، و هەر وەڵامێکیش بەهایەکی بۆداناوە بەم شێوەیە؛(نەخێر=٠، هەندێکجار=٢ ، بەڵێ=٤). نەخۆش دەبێت تەنها یەک وەڵام بۆ هەر پرسیارێک هەڵبژێرێت.
هەریەک لەم ٢٥ پرسیارەش پێوەرێک بەرامبەری هەیە، تکایە لە ڕوانگەی کلتوریی زمانی کوردی ناوەندەوە (سۆرانی)، بە دیاری کردنی نیسبەتی سەددی لەسەر پێوەرەکان ڕاو و بۆچونی خۆت دیاری بکە لە سەر شێوازی دارشتن و وشەکانی هەر پرسیارێک، لە بوارەکانی: تووندو تۆڵی, ڕۆشنی, زمانەوانی و هەروەها تێگەشتنی زۆربەی خەڵک لە مەبەستی پرسیارەکان و وەڵامەکانیان کە لە سەرەوە ئاماژەی بۆکرا . کەموکوڕیت بەدیکرد، تکایە دیاری بکە و شێوازی گونجاو ترمان بۆ بنوسە. لە بەشی سەرەوەی یەکەم پێوەر چەند مەودایەک بۆ وەڵامدانەوە دیاری کراوە بە نیسبەتی سەددی، تکایە سودمەند بە لەو مەودایانە کاتێک نیسبەکە دیاری دەکەیت.
Answers of the following (25) questions are used as a score to measure the level of handicap that produced by the problem of dizziness, for each question there are three established answers, and each answer has a specific value; ;(No=0, Sometimes=2 and Yes=4). Patient must select only one answer for each question.
Please identify on the scale beside each question, your subjective percentage rating for the consistency of the contents for each questions and their proposed answers mensioned above, in respect of meaning, lucidity and cultural understandability. Refer to the identified range of response located above the first scale. **Note: members of the focus group must compare translated questions with the original one.**

پرسیارەکان		باش نی یە کەمتر لە ٥٠%	مامناوەند لە نێوان ٥٠ – ٧٥%	باش لە نێوان ٧٥- ٩٠%	نایاب زیاتر لە ٩٠%
Questions		**Poor Less than 50%**	**Moderate between 50-75%**	**Good Between 75-90%**	**Excellent more than 90%**
P1	ئایا کێشەکەت زیاد دەبێت، ئەگەر سەیری سەرەوە بکەیت؟	0% 5 10% 15 20% 25 30% 35 40% 45 50% 55 60% 65 70% 75 80% 85 90% 95 100%			
	Does looking up increase your problem?				
E2	بەهۆی ئەم کێشەیەت، هەست بە بێزاری دەکەیت؟	0% 5 10% 15 20% 25 30% 35 40% 45 50% 55 60% 65 70% 75 80% 85 90% 95 100%			
	Because of your problem, do you feel frustrated?				

F3	بەهۆی ئەم کێشەیەت، سەفەرکردنت سنوردار کردوە، بۆ مەبەستی ئیشوکار یان حەوانەوە؟ Because of your problem, do you restrict your travel for business or recreation?	
P4	ئایا ڕۆشتن بە ڕاڕەوەکانی سوپەرمارکێت دا کێشەکانت بۆ زیاد دەکات ؟ Does walking down the aisle of a supermarket increase your problems?	
F5	بەهۆی ئەم کێشەیەت، گرفتت هەیە بۆ چونە ناو یان هاتنە دەرەوە لە جێگەدا؟ Because of your problem, do you have difficulty getting into or out of bed?	
F6	ئایا ئەم کێشەیەت، تاڕادەیەکی زۆر چالاکیە کۆمەڵایەتی یەکانت سنوردارەکات، وەکو ڕۆشتن بۆنانخواردن لە دەرەوە یان بەشداریکردن لە شایی و ئاهەنگ و پرسەکان؟ Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties?	
F7	بەهۆی ئەم کێشەیەت، گرفتی خوێندنەوەت هەیە ؟ F7. Because of your problem, do you have difficulty reading?	
P8	ئایا کێشەکەت زیاد دەبێت، ئەگەر چالاکی ئەنجام بدەیت وەک: وەرزش یان ئیشوکاری ماڵ وەک گسکدان و لابردنی شتومەک؟ Does performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away) increase your problems?	
E9	بەهۆی ئەم کێشەیەت، دەترسیت بە تەنیا لە ماڵ بچیتە دەرێ، بە بێ ئەوەی کەسێکت لەگەڵدا بێت؟ Because of your problem, are you afraid to leave your home without having someone accompany you?	
E10	بەهۆی ئەم کێشەیەت، لە بەردەم کەسانی تر هەستت بە ئیحراج بون کردوە؟	

	Because of your problem have you been embarrassed in front of others?	
P11	ئایا کێشەکەت زیاد دەبێت، ئەگەر بە خێرایی سەربجوڵێنیت؟	
	Do quick movements of your head increase your problem?	
F12	بەهۆی ئەم کێشەیەت، خۆت بە دوردەگریت لە شوێنە بەرزەکان؟	
	Because of your problem, do you avoid heights?	
P13	ئایا کێشەکەت زیاد دەبێت، ئەگەر ئەم دیو و ئەو دیو بکەیت لە جێگەدا؟	
	Does turning over in bed increase your problem?	
F14	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە بۆ تۆ کاری قورسی ناوماڵ یان باخداری بکەیت؟	
	Because of your problem, is it difficult for you to do strenuous homework or yard work?	
E15	بەهۆی ئەم کێشەیەت، دەترسی خەلک وا بزانێ تۆ مەستیت یان سەرخۆشیت ؟	
	Because of your problem, are you afraid people may think you are intoxicated?	
F16	بەهۆی ئەم کێشەیەت، زەحمەتە بەتەنها بڕۆیتە دەرەوە بۆ پیاسە؟	
	Because of your problem, is it difficult for you to go for a walk by yourself?	
P17	ئایا کێشەکەت زیاد دەبێت، ئەگەر بەسەر شۆستەدا بڕۆیت؟	
	Does walking down a sidewalk increase your problem?	
E18	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە تەرکیز بکەیت؟	
	Because of your problem, is it difficult for you to concentrate	
F19	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە لە تاریکیدا بە ناو ماڵەکەتدا بگەڕێیت؟	
	Because of your problem, is it difficult for you to walk around your house in the dark?	
E20	بەهۆی ئەم کێشەیەت، ئایا دەترسیت بە تەنیا لە ماڵ بیت؟	
	Because of your problem, are you afraid to stay home alone?	
E21	بەهۆی ئەم کێشەیەت، ئایا هەست دەکەیت پەکت کەوتوە؟	

	Because of your problem, do you feel handicapped?	
E22	ئایا ئەم کێشەیەت فشاری خستۆتە سەر پەیوەندیەکانی تۆ لەگەڵ ئەندامانی خێزانەکەت یان هاوڕێکانت؟	
	Has the problem placed stress on your relationships with members of your family or friends?	
E23	بەهۆی ئەم کێشەیەت. ئایا تۆ دڵتەنگیت؟	
	Because of your problem, are you depressed?	
F24	ئایا ئەم کێشەیەت، کاری کردۆتە سەر ئیشوکارت یان بەرپرسیاریەتی تۆ لە ماڵەوە؟	
	Does your problem interfere with your job or household responsibilities?	
P25	ئایا کێشەلەت زیاد دەبێت، لە کاتی خۆنوشتاندنەوە؟	
	Does bending over increase your problem?	

Appendix 4. Rating of the face and content validities of the Kurdish Dizziness Handicap Inventory by the members of the focus group.

CROSS-CULTURAL ADAPTATION OF CENTRAL KURDISH VERSION OF

DIZZINESS HANDICAP INVENTORY (DHI-CK)

THE FOCUS GROUP

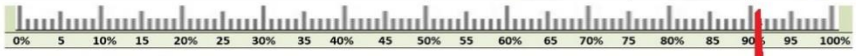
We our names and signatures below, members of the focus group of experts and consultants in the fields of vestibular disorders, otolaryngology and community medicine.

Hereby certified that under our supervision and participation and in accord with international guidelines; the translated Central-Kurdish version of ***Dizziness Handicap Inventory*** (DHI-CK) has subjected to all stages of Cross-cultural adaptation. The process witnessed four detailed panel discussions and it was completed by scoring of each of the 25 questions of the inventory by all members using a subjective self-rating visual analogue scale demonstrated below.

Note: The result of scoring will identify the face and content validity of the translated instrument.

Please identify on the scale beside each question, your subjective percentage rating for the consistency of the contents for each questions and their proposed answers mensioned above, in respect of meaning, lucidity and cultural understandability. Refer to the identified range of response located above the scale.
Note: members of the focus group must compare translated questions with the original one.

Poor Less than 50%	Moderate between 50-75%	Good Between 75- 90%	Excellent more than 90%



Names and signatures of members

Name	Signature	Name	Signature
Nizar Hamarch		Fuad Ahmed Abdulla	
Dr. Jalal Ali Hajj		Sarwat Tofiq Sam Ahmed	
Dr Yaqub Ismail			
Dr. Fakher Majeed			
Dr. Mohammed J			
Dr. Hussein Ali			
Dr. Peshraw Burhan			
Dr. Hawkar Ali			
Dr. Hunar Mohamed			
Dr. Omed Hameed			

Appendix 5. Dizziness Handicap Inventory-Kurdish Central version (DHI-KC).

ئاماری کۆسپەکانی گێژبون				
تێ بینی: لەم فۆرمەدا مەبەست لە وشەی (کێشە) بریتی یە لەو نەخۆشیە یە یان سکاڵایەی کە بەهۆیەوە سەردانی پزیشکت کردوە (گێژی، وڕی، سەرەسوڕە).				
ژمارە	پرسیارەکان	بەڵێ	هەندێکجار	نەخێر
P1	ئایا کێشەکەت زیاد دەبێت، ئەگەر سەیری سەرەوە بکەیت؟			
E2	بەهۆی ئەم کێشەیەت، هەست بە بێزاری دەکەیت؟			
F3	بەهۆی ئەم کێشەیەت، سەفەرکردنت سنوردار کردوە، بۆ مەبەستی ئیشوکار یان حەوانەوە؟			
P4	ئایا ڕۆشتن بە ڕاڕەوەکانی سوپەرمارکێت دا کێشەکانت بۆ زیاد دەکات ؟			
F5	بەهۆی ئەم کێشەیەت، گرفتت هەیە بۆ چونە ناو یان هاتنە دەرەوە لە جێگەدا؟			
F6	ئایا ئەم کێشەیەت، تارادەیەکی زۆر چالاکیە کۆمەڵایەتی یەکانت سنوردارەکات، وەکو ڕۆشتن بۆنانخواردن لە دەرەوە یان بەشداریکردن لە شایی و ئاهەنگ و پرسەکان؟			
F7	بەهۆی ئەم کێشەیەت، گرفتی خوێندنەوەت هەیە ؟			
P8	ئایا کێشەکەت زیاد دەبێت، ئەگەر چالاکی ئەنجام بدەیت وەک: وەرزش یان ئیشوکاری ماڵ وەک گسکدان و لابردنی قاپ یان شتومەک؟			
E9	بەهۆی ئەم کێشەیەت، دەترسیت بە تەنیا لە ماڵ بچیتە دەرێ، بە بێ ئەوەی کەسێکت لەگەڵدا بێت؟			
E10	بەهۆی ئەم کێشەیەت، لە بەردەم کەسانی تر هەستت بە ئیحراج بون کردوە؟			
P11	ئایا کێشەکەت زیاد دەبێت، ئەگەر بە خێرایی سەر بجوڵێنیت؟			
F12	بەهۆی ئەم کێشەیەت، خۆت بەدور دەگریت لە شوێنە بەرزەکان؟			
P13	ئایا کێشەکەت زیاد دەبێت، ئەگەر ئەمدیو و ئەودیو بکەیت لە جێگەدا؟			
F14	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە بۆ تۆ کاری قورسی ناوماڵ یان باخداری بکەیت؟			
E15	بەهۆی ئەم کێشەیەت، دەترسی خەلک وابزانێ تۆ مەستیت یان سەرخۆشیت ؟			
F16	بەهۆی ئەم کێشەیەت، زەحمەتە بەتەنها بڕۆیتە دەرەوە بۆ پیاسە؟			
P17	ئایا کێشەکەت زیاد دەبێت، ئەگەر بەسەر شۆستەدا بڕۆیت؟			
E18	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە تەرکیز بکەیت؟			
F19	بەهۆی ئەم کێشەیەت، ئایا زەحمەتە لە تاریکیدا بە ناو ماڵەکەتدا بگەڕێیت؟			
E20	بەهۆی ئەم کێشەیەت، ئایا دەترسیت بەتەنها لە ماڵ بیت؟			
E21	بەهۆی ئەم کێشەیەت، ئایا هەست دەکەیت پەکتکەوتوە؟			
E22	ئایا ئەم کێشەیەت فشاری خستۆتە سەر پەیوەندیەکانی تۆ لەگەڵ ئەندامانی خێزانەکەت یان هاوڕێکانت؟			
E23	بەهۆی ئەم کێشەیەت. ئایا تۆ دڵتەنگیت؟			
F24	ئایا ئەم کێشەیەت، کاری کردۆتە سەر ئیشوکارت یان بەڕپرسیاریەتی تۆ لە ماڵەوە؟			
P25	ئایا کێشەکەت زیاد دەبێت، لە کاتی خۆنوشتاندنەوە؟			

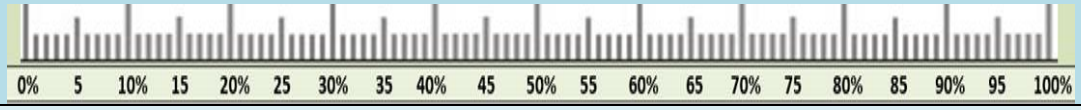
Appendix 6. Visual analogue scale of global impact resulted from vestibular disorders (English form).

Visual analogue scale for Subjective self-rating of the global impact of the vestibular symptoms

Please score your overall resulted handicap since the vestibular symptoms onset.

Zero means no impacts, 100 means the highest speculative impacts.

Kindly refer to the listed below definitions for different feelings and symptoms. Do not hesitate to ask for further explanation.



Vestibular Symptoms: according to classification of vestibular symptoms by Barany Society [10] it contains:

1-internal vertigo: the sensation of self-motion when no self-motion is occurring, spinning or non-spinning.

2- Dizziness: Spatial disorientation.

3- Vestibulo-visual symptoms: it includes:

a. External vertigo: false sensation that the visual surround is spinning or flowing;
b. Oscillopsia: the false sensation that the visual surround is oscillating;
c. Visual lag: the false sensation that the visual surround follows behind;
d. Visual tilt: the false perception of the visual surround as oriented off the true vertical;
e. Movement-induced blur: reduced visual acuity during or momentarily after a head movement.

4- Postural symptoms: are balance symptoms related to maintenance of postural stability, it includes:

a. Unsteadiness: the feeling of being unstable while seated, standing, or walking;
b. Directional pulsion: the feeling of being unstable with a tendency to veer or fall in a particular direction while seated, standing, or walking;
c. Balance-related near fall: a sensation of imminent fall (without a completed fall); and
d. Balance-related fall: a completed fall.

Note: definitions were exactly adopted from the reference.

References:

1. Bisdorff A, Von Brevern M, Lempert T, Newman-Toker DE. Classification of vestibular symptoms: towards an international classification of vestibular disorders. J Vestib Res. 2009;19(1-2):1–13.

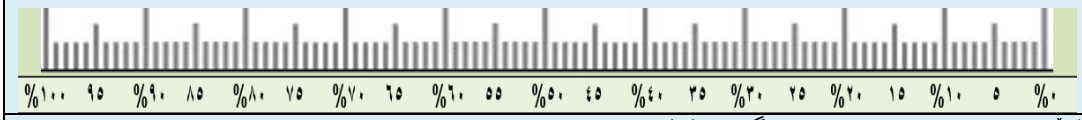
Appendix 7. Visual analogue scale of global impact resulted from vestibular disorders (Kurdish form).

Visual analogue scale for Subjective self-rating of global impact of the vestibular symptoms		
پێوەری دیاریکردنی نیسبەتی سەددی بۆ پەککەوتەیی بە هۆی کاریگەری سکالاکانی پەیوەست بە سەرەسوڕە و گێژبون		
ناوی بەشداربو:	**تەمەن:**	**رەگەز:**
بەروار:	**ID:**	

تکایە بە دیاری کردنی نیسبەتی سەددی، رێژەی پەککەوتن کە پەیدا بووە لە تۆدا بە هۆی کاریگەری سکالاکانی پەیوەست بە سەرەسوڕە و گێژبون لە سەرەیایی دروست بونیەوە لەم پێوەرەی خوارەوەدا دیاری بکە

تێ بینی: سودمەند بە لەم زانیاریانەی خوارەوە وەک رێنیشاندەر و بەکاری بهێنە بۆ دیاریکردنی نیسبەتی سەددی، تکایە دودڵ مەبە لە پرسیار کردن بۆ زیاتر ڕونکردنەوە.

1. سفر واتە نەبونی پەککەوتن، سەد واتە زۆرترین کاریگەری و پەککەوتن.
2. پێناسەی سکالاکان کە لە خوارەوە نوسراوە.



سکالاکانی پەیوەست بە سەرەسوڕێ و گێژبون [10]:

ا) خۆخولێ : واتە تۆ هەست دەکەیت دەجوڵێیت لە کاتێکدا جوڵەی ڕاستەقینە لە تۆدا بوونی نی یە (گەندە هەست). مەبەست لە جوڵەکە دو شێوەیە: سورانەوە و شێوەی تر وەک ڕاژەنین یان لاربونەوە

ب) وڕی (گێژی): شێواوی لە توانای جێگەناسیدا وەک ئەوەی هەست بکەیت کە بەسەر عەرزەوە نیت

ج) سکالاکانی ڤستیبیول – بینایی: ئەمانەش وەک

1 - **سورانەوە یان ڕۆشتنی دەورەبەر**
2 - **لەرەبینی** واتە هەست بکەیت بە بونی جوڵەیەکی جوت ئاڕاستە (جوڵەیەکی ناڕاستەقینە) لە دەوروبەردا بەشێوەی چون وهاتن
3 - **پاشکەوتنی دیمەنەکان** : واتە گەندەهەستێک بە پاشکەوتنی دیمەنەکان لە کاتی جوڵەی سەردا
4 - **لاربونی دیمەنی دەوروبەر:** گەندەهەستێک کە وا دەبینی شتەکانی دەوروبەر شاقوڵی(ستونی) نین، بەڵکو لایان داوە لە شاقوڵی واتە لار بوون
5 - **لێڵ بونی چاو بەهۆی جوڵەوە**: ێ هێزبونی هەستی بینین (کەمبینی) لە کاتی جوڵەدا

د) سکالاکانی جێگیری لەش: ئەمانەش وەک:

1 - **مۆلەقەیی** واتە ناجێگیریی
2 - **ڕەتڵدان یان لاربونەوە بەلایەکدا**
3 - **نزیکەکەوتن**: خەریک بێت بکەویت بە هۆی تێکچونی هاوسەنگی یەوە
4 - **کەوتن**: کەوتنی تەواو بەهۆی تێکچونی هاوسەنگی یەوە

Reference

1 - Bisdorff, A., M. Von Brevern, T. Lempert, and D. E. Newman-Toker. 2009. Classification of vestibular symptoms: towards an international classification of vestibular disorders. Journal of Vestibular Research 19, no. 1-2:1-13. doi: 10.3233/ves-2009-0343.

Appendix 8. Clinical Test of Sensory Interaction in Balance (English form).

Clinical Test of Sensory Interaction in Balance (CTSIB)					
Name:		Age:		Sex:	
Date:		ID:			
Conditions		Trial 1	Trial 2	Trial 3	Mean
Condition 1	Stable and flat surface with eyes open				
Condition 2	Stable and flat surface with eyes-closed				
Condition 3	Stable and flat surface with eyes-open and an overhead contention dome				
Condition 4	Compliant spongy surface with eyes open				
Condition 5	Compliant spongy surface with eyes closed				
Condition 6	Compliant spongy surface with eyes open and an overhead contention dome				
Total sum of all six conditions out of 360 seconds					

Notes:

1- The test should be implemented in a quiet room; so that, the patient cannot use his/her auditory stimuli for balance.
2- Each condition will be completed if the participant has maintained balance for total 60 seconds, in any of the three trials, that is to say, no need for further trial, otherwise for each condition three trials are needed.
3- For each condition participant must stand on touching, stocking feet, both hands across their chest right hand over left shoulder and left hand over right shoulder, and looking straightforward.
4- In the beginning of each trial time is measured by using stopwatch.
5- Each trial will be ended in these situations.
   - Completion of 60 seconds successfully without loss of balance.
   - Moving their hands over shoulder.
   - Loss of balance in a way that participant needs assistant or use his or her hands to prevent fall before completion of 60 seconds.
   - Opening eyes before completion of 60 seconds in eyes closed conditions.

Calculation:

- Mean of each condition is equal to the sum (in seconds) of available trial/s in that condition divided by numbers of the trial/s.
- Total sum is equal to the sum of the means of all six conditions.

Appendix 9. Clinical Test of Sensory Interaction in Balance (Kurdish form).

ناوی بەشداربو:	**ڕەگەز:**	**تەمەن:**		
بەروار:	**ID:**			
دۆخ	**هەوڵی یەکەم بەچرکە**	**هەوڵی دووەم بە چرکە**	**هەوڵی سێیەم بە چرکە**	**کۆی چرکە بۆ هەر دۆخێک**
دۆخی یەکەم: چاو کراوەبێت، ڕوبەڕێکی ڕەق				
دۆخی دووەم: چاو داخراوبێت، ڕوبەڕێکی ڕەق				
دۆخی سێ یەم: چاو کراوە بێت، دیمەنی دژوار، ڕوبەڕێکی ڕەق،				
دۆخی چوارەم: چاو کراوەبێت، ڕوبەڕێکی ئیسفەنجی				
دۆخی پێنجەم: چاو داخراوبێت، ڕوبەڕێکی ئیسفەنجی				
دۆخی شەشەم: چاو کراوە بێت، دیمەنی دژوار، ڕوبەڕێکی ئیسفەنجی				
	کۆی گشتی چرکەکان لە ٣٦٠			

ڕێنماییەکان

1 - هەر دۆخێک تەواو دەبێت ئەگەر بەشداربو توانی یەکەم هەوڵ بە سەرکەوتویی ئەنجام بدات (واتە تەواوی ٦٠چرکە تێپەڕبکات بە بێ ئەوەی هاوسەنگی لە دەست بدات).

2 - بۆ هەر دۆخێک بەشدار بو پێویستە هەوڵی دووەم ئەنجام بدات ئەگەر نەیتوانی ٦٠ چرکە تێپەڕێنێت لە هەوڵی یەکەمدا، هەوڵی سێیەم کاتێک پێویست دەکات ئەگەر بەشداربو نەیتوانی هەوڵی دووەمیش تێپەڕ بکات.

3 - لە کاتی ئەنجامدانی دۆخەکاندا پێویستە بەشداربو تەنها گۆڕەوی لە پێدا بێت، بەپێوە بوەستێت، قاچەکانی جوتبکات، لەپی دەستی ڕاستی بخاتە سەر شانی چەپی و لەپی دەستی چەپی بخاتە سەر شانی ڕاستی و هەروەها سەیری پێشەوە بکات.

4 - لە سەرەتای دەستپێکردنی هەر دۆخێک کات دەژمێردرێت بە هۆی کاتژمێری کاتگرتن (Stopwatch).

5 - هەر هەوڵێک تەواو دەبێت لەم حاڵەتانەدا:

- بەڕیکردنی ٦٠چرکە بە سەرکەوتویی.
- لابردنی دەست لە سەر یەکێک لە شانەکان یان هەردوکیان پێش تەواوبونی ٦٠چرکە.
- لە دەستدانی هاوسەنگی بەشێوەیەک بەشداربو پێویستی بە یارمەتی دەستی خۆی یان یەکێکی تر بێت بۆ ئەوەی خۆی بپارێزی لە کەوتن پێش تەواوبونی ٦٠چرکە.
- کردنەوەی چاو پێش تەواوبونی ٦٠چرکە، لەو دۆخانەی کە چاو داخستنی تێدایە.
- ژمارەی چرکە بۆ هەر دۆخێک دەکاتەکۆی چرکەکانی هەوڵەکان دابەش بەسەر ژمارەی هەوڵەکاندا بۆ ئەو دۆخە.
- کۆی گشتی دەکاتە کۆی ژمارەی چرکەکانی هەر شەش دۆخەکە.

Appendix 10. Vertigo symptom Scale - Short form.

We would like to know what dizziness related symptoms you have had just recently. Please circle the appropriate number to indicate about how many times you have experienced each of the symptoms listed below during the past month. The range of response is						
0 = Never	1 = A few times	2 = Several times	3 = Quite often (every week)		4 = Very often (most days)	
How often in the past month have you had the following symptoms:						
1	A feeling that either you, or things around you, are spinning or moving , lasting *less* than 20 minutes		0	1	2	3	4
2	Hot or cold spells		0	1	2	3	4
3	Nausea (feeling sick), vomiting		0	1	2	3	4
4	A feeling that either you, or things around you, are spinning or moving , lasting *more* than 20 minutes		0	1	2	3	4
5	Heart pounding or fluttering		0	1	2	3	4
6	A feeling of being dizzy, disoriented or "swimmy" lasting all days		0	1	2	3	4
7	Headache, or feeling pressure in the head		0	1	2	3	4
8	Unable to stand or walk properly without support, veering or staggering to one side		0	1	2	3	4
9	Difficulty breathing, short of breath		0	1	2	3	4
10	Feeling unsteady, about to loss balance, lasting *more* than 20 minutes		0	1	2	3	4
11	Excessive sweating		0	1	2	3	4
12	Feeling faint about to black out		0	1	2	3	4
13	Feeling unsteady, about to loss balance, lasting *less* than 20 minutes		0	1	2	3	4
14	Pains in the heart or chest region		0	1	2	3	4
15	A feeling of being dizzy, disoriented or "swimmy" lasting *less* than 20 minutes		0	1	2	3	4

Appendix 11. Email shows permission for Kurdish cross-cultural validation of the DHI from the original developer.

permissiom

Dr.Sherko Zmnako <sherko.zmnako@gmail.com>

to Lucy.Yardley

Dear professor Lucy Yardley
Good day
it's my pleasure to email you
I will be honored if you give me permission to translate and later publish
Vertigo Symptom scale - the original one 34- items
and
Vertigo Symptom scale - Short form 15- items

to **Kurdish-central** language

Note: there are about more than seven million people speaking with the mentioned language around different countries. **https://www.ethnologue.com/language/ckb .**
with approval of your permission we will be able to provide a service to medical community in this locality**.**

waiting for your respected reply
thanks and please accept my regards

Re: permission new

Inbox x

Lucy Yardley <lucy.yardley@bristol.ac.uk> Thu, Apr 26, 2018, 5:18 PM

to me

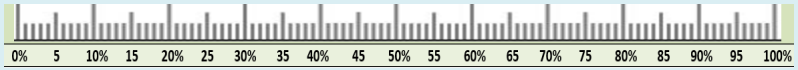
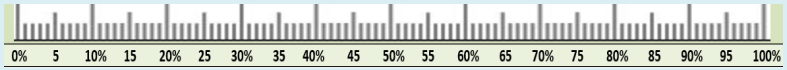
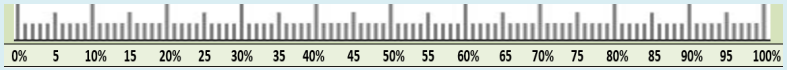
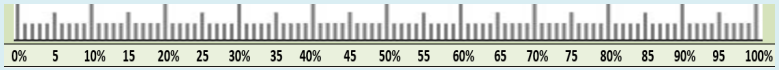
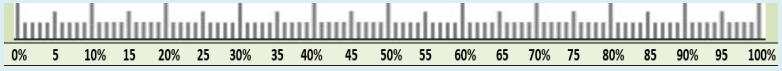
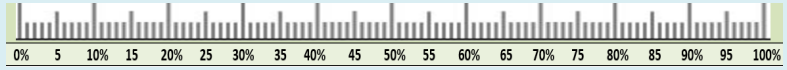
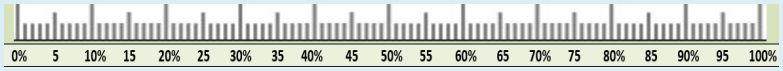
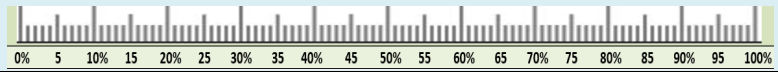
You are very welcome,

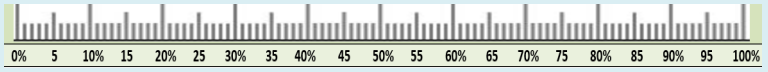
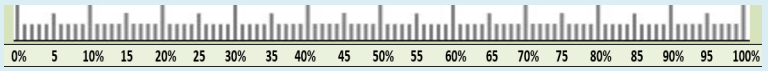
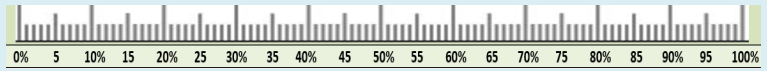
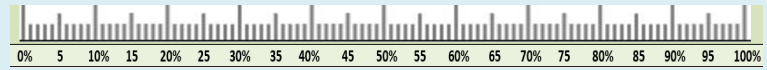
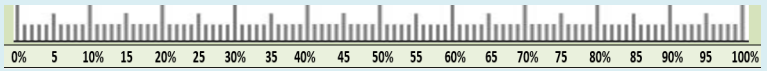
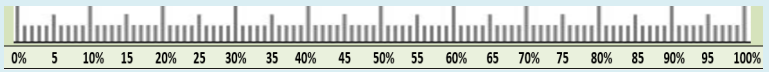
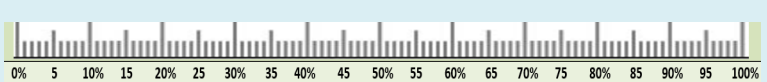
Best wishes,
Lucy

Appendix 12. Specific rating scale for content and face validation of Certigo Symptom Scale – Short form into central Kurdish dialect.

دیاریکردنی وەلام بۆ چەندجارە توشبونی ئەم (١٥) سکالاینەی خوارەوە و ئەژمارکردنی بەهای ئەو وەڵامانە به کاردەهێنرێ وەک پێوەرێک بۆ دیاریکردنی ڕادەی هێزی سکالاکانی سەرەسورە، بۆ هەر پرسیارێک تەنها پێنج وەڵام هەیە، و هەر وەڵامێکیش بەهایەکی بۆدانراوە بەم شێوەیە؛(هیچ کات=٠، کەمجار=١ ، هەندێجار=٢، زۆرجار=٣، هەموکات=٤). نەخۆش دەبێت تەنها یەک وەڵام بۆ هەر پرسیارێک هەڵبژێرێت.
هەریەک لەم ١٥ سکالایەش پێوەرێک بەرامبەری هەیە، تکایە لە ڕوانگەی کلتوریی زمانی کوردی ناوەندەوە (سۆرانی)، بە دیاری کردنی نیسبەتی سەددی لەسەر پێوەرەکان ڕاو و بۆچونی خۆت دیاری بکە لە سەر شێوازی دارشتن و وشەکانی هەر سکالایەک، لە بوارەکانی: تووندو تۆڵی ,ڕۆشنی, زمانەوانی و هەروەها تێگەشتنی زۆربەی خەڵک لە مەبەستی سکالاکان و وەڵامەکانیان کە لە سەرەوە ئاماژەی بۆکرا . کەموکوڕیت بەدیکرد، تکایە دیاری بکە و شێوازی گونجاو ترمان بۆ بنوسە. لە بەشی سەرەوەی یەکەم پێوەر چەند مەودایەک بۆ وەڵامدانەوە دیاری کراوە بە نیسبەتی سەددی، تکایە سودمەند بە لەو مەودایانە کاتێک نیسبەکە دیاری دەکەیت.
Answers of the following (15) symptoms are used as a score to measure the level of impact that produced by vestibular disorders, for each symptom there are five established answers, and each answer has a specific value; ;(never=0, a few times=2 several times=3, quite often=3 and very often=4). Patient must select only one answer for each symptom.
Please identify on each scale, your subjective percentage rating for the consistency of the contents of each of the following 15 symptoms in regard of meaning, lucidity and cultural understandability. Refer to the identified range of response located above the scales. Note: members of the focus group must compare translated symptoms with the original one.

سکالاکان	باش نی یە کەمتر لە	مامناوەند لە نێوان ٥٠ – ٧٥%	باش لە نێوان ٧٥-٩٠%	نایاب زیاتر لە ٩٠%

	Symptoms	Poor Less than 50%	Moderate between 50-75%	Good Between 75-90%	Excellent more than 90%
1	هەستکردن کە خۆت یان شتەکانی دەوروبەرت دەسوڕێنەوە یان دەجوڵێن بۆ ماوەی کەمتر لە (٢٠) دەقیقە A feeling that either you, or things around you, are spinning or moving, lasting less than 20 minutes				
2	نۆبەی گەرما یان سەرما Hot or cold spells				
3	دڵ تێکهەڵاتن ، ڕشانەوە Nausea (feeling sick), vomiting				
4	هەستکردن کە خۆت یان شتەکانی دەوروبەرت دەسوڕێنەوە یان دەجوڵێن بۆ ماوەی زیاتر لە (٢٠) دەقیقە A feeling that either you, or things around you, are spinning or moving, lasting more than 20 minutes				
5	دڵ پەلەپەل کردن یان دڵەکوتێ Heart pounding or fluttering				
6	هەستکردن بەوەی کە گێژی یان وڕی یان بە سەر عەرزەوە نیت بە درێژایی ڕۆژ A feeling of being dizzy, disoriented or “swimmy” lasting all day				
7	سەرئێشە یان هەستکردن بەوەی سەرت قورسە Headache, or feeling of pressure in the head				
8	نەتوانی بەباشی بەپێوە بوەستیت یان ڕێ بکەیت بە بێ دەستگرتن یان یارمەتی، ڕەتڵدان یان بەلاداکەوتن				

	Unable to stand or walk properly without support, veering or staggering to one side	
9	هەناسەتوندی یان هەناسەسواری Difficulty breathing, been short of breath	
10	هەستکردن بە ناجێگیری، خەریک بێت تەوازن لە دەست بدەیت بۆ ماوەی زیاتر لە (٢٠) دەقەقە Feeling unsteady, about to lose balance, lasting more than 20 minutes	
11	ئارەقەکردنەوەی زۆر Excessive sweating	
12	هەستکردن بە بێ هێزی ، خەریک بێت ببورێیتەوە Feeling faint, about to black out	
13	هەستکردن بە ناجێگیری، خەریک بێت تەوازن لە دەست بدەیت بۆ ماوەی کەمتر لە (٢٠) دەقەقە Feeling unsteady, about to lose balance, lasting less than 20 minutes	
14	ئازاری دڵ یان سنگ Pains in the heart or chest region	
15	هەستکردن بەوەی کە گێژی یان وری یان بە سەر عەرزەوە نیت بۆ ماوەی کەمتر لە (٢٠) دەقەقە A feeling of being dizzy disoriented or "swimmy", lasting less than 20 minutes	

Appendix 13. Rating of the face and content validities of the Kurdish Vertigo Symptom scale – Short form by the members of the focus group.

CROSS-CULTURAL ADAPTATION OF CENTRAL-KURDISH VERSION OF THE

VERTIGO SYMPTOM SCALE-SHORT FORM (VSS-SF-CK)

THE FOCUS GROUP

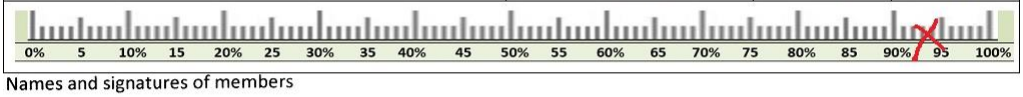
We our names and signatures below, members of the focus group of experts and consultants in the fields of vestibular disorders, otolaryngology and community medicine.

Hereby certified that under our supervision and participation and in accord with international guidelines; the translated Central-Kurdish version of ***vertigo symptom scale-short form*** (VSS-SF-CK) has subjected to all stages of Cross-cultural adaptation. The process witnessed four detailed panel discussions and it was completed by scoring of each of the 15 symptoms on the scale by all members using a subjective self-rating visual analogue scale demonstrated below.

Note: The result of scoring will identify the face and content validity of the translated instrument.

Please identify on the scale beside each question, your subjective percentage rating for the consistency of the contents for each questions and their proposed answers mensioned above, in respect of meaning, lucidity and cultural understandability. Refer to the identified range of response located above the scale. Note: members of the focus group must compare translated questions with the original one.

Poor Less than 50%	Moderate between 50-75%	Good Between 75-90%	Excellent more than 90%



Names and signatures of members

Name	Signature	Name	Signature
Shakow Abdulrehmanezzaddin		Dr. Fuad Ahmed Abdalla	
Peshrawbarham		Dr. Serwet Tawfiq Jan	
Mohammed Jaz		Dr Yoas. F Salih	
Fakher Majeed			
Amed Lemeed Ali			
Hussein Ali			
Hawkar Ali			
Shkar Nazar Mohammed			
Huner Mohammed Hasan Amin			

Appendix 14. Vertigo symptom Scale - short form – Central hurdish (VSS-SF-CK).

ناوی نەخۆش:	**ڕەگەز:**	تەمەن:
بەروار:	ID:	

Vertigo Symptom Scale (short form) VSS-SF-CK
پێوەری سکاڵای سەرەخولێ- فۆرمی کورت

حەز دەکەین بزانین، کامانەن ئەو سکاڵایانەی کە پەیوەندیان بە گێژبونەوە هەبووە و ئێوە هەتانبووە لەم ماوەیەی پێشودا، تکایە ژمارەی گونجاو دیاری بکە بەرامبەر هەر سکاڵایەک لەم لیستەی خوارەوەدا، بۆ ئەوەی دەربکەوێت کە چەندجار هەتانبوە لە ماوەی مانگی پێشودا، تۆندی هەر ژمارەیەک لەخوارەوە دیاری کراوە

٠ یەعنی هیچ کات	١ یەعنی کەمجار	٢ یەعنی هەندێ جار	٣ یەعنی زۆرجار	**٤ یەعنی هەموکات (دایم)**

	سکاڵا	**هیچ کات**	**کەمجار**	**هەندێ جار**	**زۆرجار**	دایم
١	هەستکردن کە خۆت یان شتەکانی دەوروبەرت دەسوڕێنەوە یان دەجوڵێن بۆ ماوەی کەمتر لە (٢٠) دەقەقە	٠	١	٢	٣	٤
٢	نۆبەی گەرما یان سەرما (تاوی گەرما یان سەرما)	٠	١	٢	٣	٤
٣	دڵ تێکهەڵاتن ، ڕشانەوە	٠	١	٢	٣	٤
٤	هەستکردن کە خۆت یان شتەکانی دەوروبەرت دەسوڕێنەوە یان دەجوڵێن بۆ ماوەی زیاتر لە (٢٠) دەقەقە	٠	١	٢	٣	٤
٥	دڵ پەلەپەل کردن یان دڵەکوتێ	٠	١	٢	٣	٤
٦	هەستکردن بەوەی کە گێژی یان وڕی یان بە سەر عەرزەوە نیت بە درێژایی ڕۆژ	٠	١	٢	٣	٤
٧	سەرئێشە یان هەستکردن بەوەی سەرت قورسە	٠	١	٢	٣	٤
٨	نەتوانی بەباشی بەپێوە بوەستیت یان ڕێ بکەیت بە بێ دەستگرتن یان یارمەتی، ڕەتڵدان یان بەلاداکەوتن	٠	١	٢	٣	٤
٩	هەناسەتوندی یان هەناسەسواری	٠	١	٢	٣	٤
١٠	هەستکردن بە ناجێگیری، خەریک بێت هاوسەنگی (تەوازن) لە دەست بدەیت بۆ ماوەی زیاتر لە (٢٠) دەقەقە	٠	١	٢	٣	٤
١١	ئارەقەکردنەوەی زۆر	٠	١	٢	٣	٤
١٢	هەستکردن بە بێ هێزی ، خەریک بێت ببورێیتەوە	٠	١	٢	٣	٤
١٣	هەستکردن بە ناجێگیری، خەریک بێت هاوسەنگی (تەوازن) لە دەست بدەیت بۆ ماوەی کەمتر لە (٢٠) دەقەقە	٠	١	٢	٣	٤
١٤	ئازاری دڵ یان سنگ	٠	١	٢	٣	٤
١٥	هەستکردن بەوەی کە گێژی یان وڕی یان بە سەر عەرزەوە نیت بۆ ماوەی کەمتر لە (٢٠) دەقەقە	٠	١	٢	٣	٤

Appendix 15. Tandem Romberg (English form).

Tandem Romberg [80]					
Name:		Age:		Sex:	
Date:		ID:			
Conditions		Trial 1	Trial 2	Trial 3	Mean
Condition 1	Right foot behind the left, eyes open				
Condition 2	Right foot behind the left, eyes closed				
Condition 3	Left foot behind the right, eyes open				
Condition 4	Left foot behind the right, eyes closed				
Total sum of all four conditions out of 240 seconds					

Notes:

1- The test should be implemented in a quiet room; so that, the patient cannot use his/her auditory stimuli for balance.
2- A printed figure of two straight feet one in front of the other (toe to heel) without angulation glued on a stable flat ground. Participants were asked to stand quietly wearing socks and maintain balance on the figure.
3- Each condition will be completed if the participant has maintained balance for total 60 seconds, in any of the three trials, that is to say, no need for further trial; otherwise, for each condition three trials are needed.
4- Both hands of the participant across their chest right hand over left shoulder and left hand over right shoulder, and looking straightforward.
5- In the beginning of each trial time is measured by using stopwatch.
6- Each trial will be ended in the following situations.
    - Completion of 60 seconds successfully without loss of balance.
    - Moving their hands over shoulder.
    - Loss of balance in a way that participant needs assistant or use his or her hands to prevent fall before completion of 60 seconds.
    - Opening eyes before completion of 60 seconds in eyes closed conditions.

Calculation:

- Mean of each condition is equal to the sum (in seconds) of available trial/s in that condition divided by numbers of the trial/s.
- Total sum is equal to the sum of the means of all four conditions.

References:

1. Johnson BG, Wright AD, Beazley MF, Harvey TC, Hillenbrand P, Imray CHE. The Sharpened Romberg Test for Assessing Ataxia in Mild Acute Mountain Sickness. Wilderness Environ Med. 2005;16(2):62–6.

Appendix 16. Tandem Romberg (Kurdish form).

ناوی بەشداربو:	ڕەگەز:	تەمەن:		
بەروار:		ID:		
دۆخ	هەوڵی یەکەم بەچرکە	هەوڵی دووەم بە چرکە	هەوڵی سێیەم بە چرکە	کۆی چرکە بۆ هەر دۆخێک
دۆخی یەکەم: پاژنە بۆ پەنجەگەورە قاچی ڕاست لە پێشەوە، چاو کراوەبێت، ڕوبەڕێکی ڕەق				
دۆخی دووەم: پاژنە بۆ پەنجەگەورە قاچی ڕاست لە پێشەوە، چاو داخراوبێت، ڕوبەڕێکی ڕەق				
دۆخی سێیەم: : پاژنە بۆ پەنجەگەورە قاچی چەپ لە پێشەوە، چاو کراوەبێت، ڕوبەڕێکی ڕەق				
دۆخی چوارەم: پاژنە بۆ پەنجەگەورە قاچی چەپ لە پێشەوە، چاو داخراوبێت، ڕوبەڕێکی ڕەق				
کۆی گشتی چرکەکان لە ٢٤٠				

ڕێنماییەکان

6- هەر دۆخێک تەواو دەبێت ئەگەر بەشداربو توانی یەکەم هەوڵ بە سەرکەوتویی ئەنجام بدات (واتە تەواوی ٦٠ چرکە تێپەڕبکات بە بێ ئەوەی هاوسەنگی لە دەست بدات).

7- بۆ هەر دۆخێک بەشدار بو پێویستە هەوڵی دووەم ئەنجام بدات ئەگەر نەیتوانی ٦٠ چرکە تێپەڕێنێت لە هەوڵی یەکەمدا، هەوڵی سێیەم کاتێک پێویست دەکات ئەگەر بەشداربو نەیتوانی هەوڵی دووەمیش تێپەڕ بکات.

8- لە کاتی ئەنجامدانی دۆخەکاندا پێویستە بەشداربو پێلاوەکانی دەبکەنێت تەنها گۆرەوی لە پێدا بێت، بەپێوە بوەستێت، قاچەکانی جوتبکات، دەستی ڕاستی بخاتە سەر شانی چەپی و دەستی چەپی بخاتە سەر شانی ڕاستی و هەروەها سەیری پێشەوە بکات.

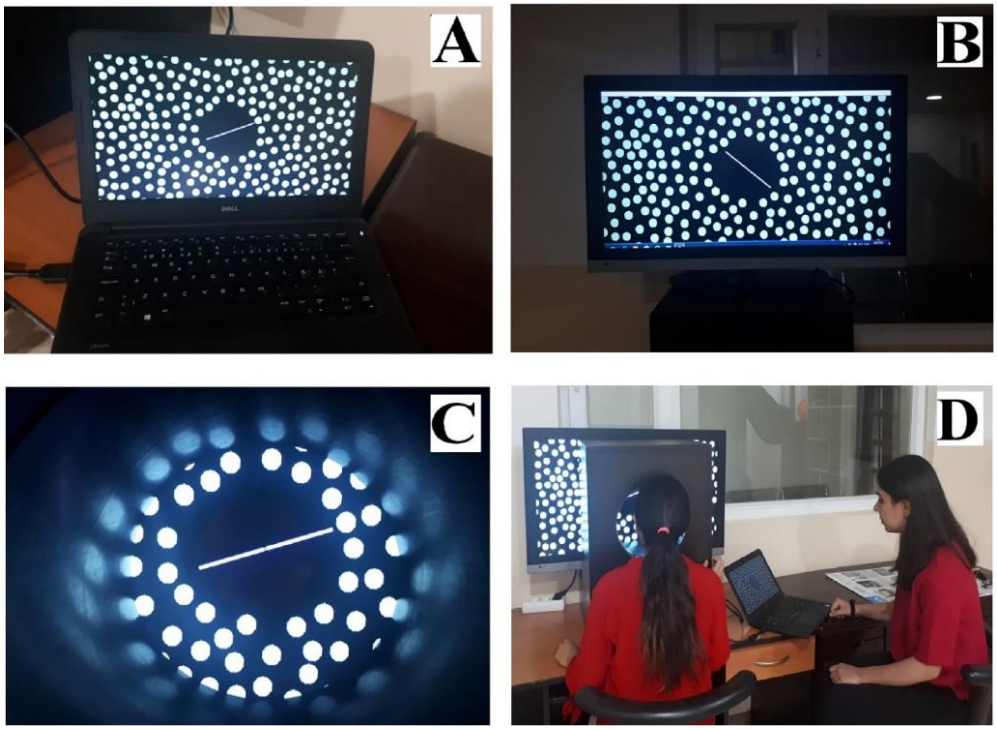
9- لە سەرەتای دەستپێکردنی هەر دۆخێک کات دەژمێردرێت بە هۆی کاتژمێری کاتگرتن (Stopwatch).

10- هەر هەوڵێک تەواو دەبێت لەم حاڵەتانەدا:

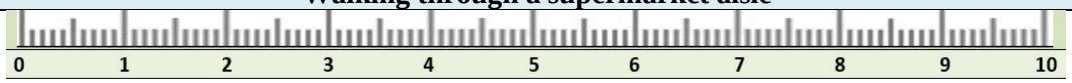
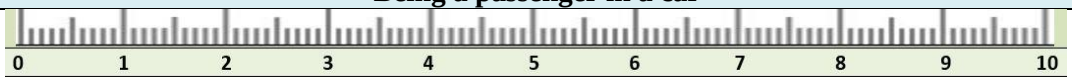
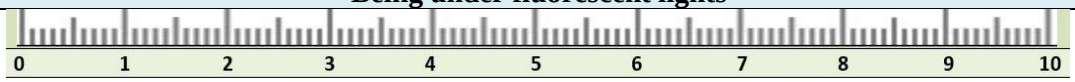
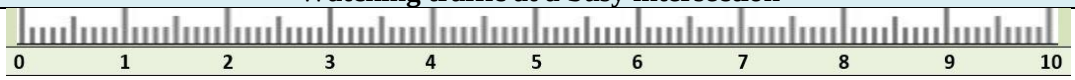
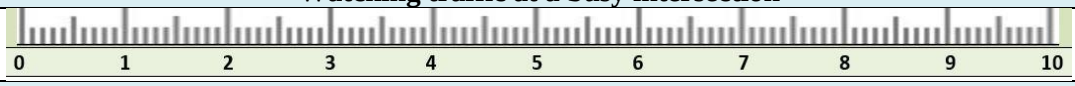
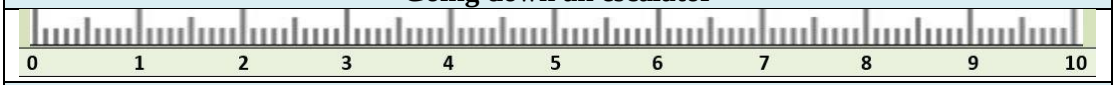
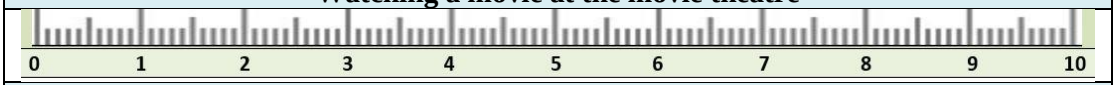
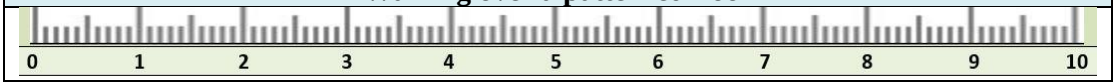
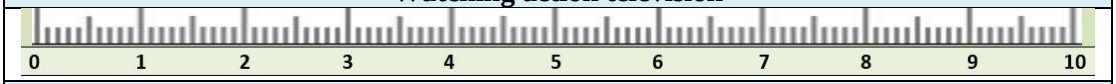
- بەڕێکردنی ٦٠چرکە بە سەرکەوتویی.
- لابردنی لەپی دەست لە سەر یەکێک لە شانەکان یان هەردوکیان پێش تەواوبونی ٦٠چرکە.
- لە دەستدانی هاوسەنگی بەشێوەیەک بەشداربو پێویستی بە یارمەتی دەستی خۆی یان یەکێکی تر بێت بۆ ئەوەی خۆی بپارێزی لە کەوتن پێش تەواوبونی ٦٠چرکە.
- کردنەوەی چاو پێش تەواوبونی ٣٠چرکە، لەو دۆخانەی کە چاو داخستنی تێدایە.
- ژمارەی چرکە بۆ هەر دۆخێک دەکاتەکۆی چرکەکانی هەوڵەکان دابەش بەسەر ژمارەی هەوڵەکاندا بۆ ئەو دۆخە.
- کۆی گشتی دەکاتە کۆی ژمارەی چرکەکانی هەر چوار دۆخەکە
-

Appendix 17. Visual dependency measure by Rod-and-Disk program.

A. A laptop to run the program.
B. A high definition screen connected to the laptop to display the content of the program.
C. A black painted cone through which the patient looks to the content of the program.
D. An operator sitting beside a patient measuring her visual dependency.



Appendix 18. Visual Vertigo Analogue Scale (English form).

Adapted from Longridge et al., 2002	
Indicate the amount of dizziness you experience in the following situations by marking off the scales below.	
10 = Maximun visuall induced Vestibular symptoms	**0 = No visually induced vestibular symptoms**
Walking through a supermarket aisle	
	
Being a passenger in a car	
	
Being under fluorescent lights	
	
Watching traffic at a busy intersection	
	
Watching traffic at a busy intersection	
	
Going down an escalator	
	
Watching a movie at the movie theatre	
	
Walking over a patterned floor	
	
Watching action television	
	

Appendix 19. Visual Vertigo Analogue Scale (Kurdish form).

ناوی بەشداربو	تەمەن:	ڕەگەز
بەروار:		ID:
بڕی گێژبونەکەت دیاری بکە، لە هەر یەکێک لەم حاڵەتانەی خوارەوەدا. (ئ بینی: ئەگەر هەر حاڵەتێکت تاقی نەکردۆتەوە وەلامی مەدەرەوە.)		
ژمارە (١٠) دە واتە زۆرترین گێژبون		ژمارە (٠)سفر واتە گێژبون نی یە
ڕۆشتن بە ڕاڕەوەکانی سوپەرمارکێتدا		
0 1 2 3 4 5 6 7 8 9 10		
نەفەر بیت لە ناو سەیارەیەکدا		
0 1 2 3 4 5 6 7 8 9 10		
لەژێر گلۆپێکی سپی دا بیت		
0 1 2 3 4 5 6 7 8 9 10		
سەیری ترافیک بکەیت لە فولکەیەکی قەرەباڵغدا		
0 1 2 3 4 5 6 7 8 9 10		
ڕوشتن بەناو بازارێکی قەرەباڵغدا		
0 1 2 3 4 5 6 7 8 9 10		
سەرکەوتن یان دابەزین بە قادرمەی کارەبایی		
0 1 2 3 4 5 6 7 8 9 10		
سەیرکردنی فلیم لە سینەمادا		
0 1 2 3 4 5 6 7 8 9 10		
ڕۆشتن بەسەر عەرزێک کە نەخشی دوبارەبووی هەبێت		
0 1 2 3 4 5 6 7 8 9 10		
سەیرکردنی فلیمی ئاکشن لە تەلەفزیۆن		
0 1 2 3 4 5 6 7 8 9 10		
کۆی وەڵامەکان دابەش بەسەر ژمارەی وەڵامەکان		

Appendix 20. Modified Cawthorne-Cooksey Exercise Protocol (MCP).

١	به دانیشتانەوە ڕۆژی چوار جار، جولاندنی سەر	
	١	بۆ سەرەوە دواتر بۆ خوارەوە ٢٠ جار (١٠ جار بە خاوی ، ١٠ جار بە خێرایی)
	٢	بۆ ڕاست و چەپ ٢٠ جار (١٠ جار بە خاوی ، ١٠ جار بە خێرایی)
	٣	جولانەوە و خولانەوەی (هەلتەکاندنی) هەردوو شان ٢٠ جار
	٤	نوشتانەوە و هەڵگرتنی شت و مەک لە زەوی (١٠ جار بە دەستی ڕاست ١٠ جار بە دەستی چەپ)
٢	بە سەرپێوە: ٢٠ جار	
	١	وەکو ڕاهێنانەکانی سەرەوە جگە لە خاڵی چوارەم
	٢	هەڵسانە سەر پێ و دانیشتن (١٠ جار بە چاوکراوەیی و ١٠ جار بە چاو داخراوی)
	٣	هەڵدانی تۆپ لە دەستێکەوە بۆ دەستێکی تر، بە شێوەیەک لەسەرو چاوتەوە بروات و تەرکیز .کردنە سەر تۆپەکە بێ جولاندنی شان و مل
	٤	جولاندنی تۆپ لە دەستێکەوە بەرەو دەستێکی تر لە ژێر ئەژنۆوە
	٥	هەڵسانە سەر پێ دواتر خۆ خولانەوە (سوڕانەوە) پاشان دانیشتن
٣	ڕۆشتن بە پێ	
	١	یاری کردن لەگەڵ کەسێک بە تۆپ بە شێوەیەک کە کەسەکە لە شوێنێکدا جێگیر بوەستێ - و تۆش بە دەوریدا بسووڕێتەوە و تۆپی بدەیدێ وئەویش بتداتەوە. (٢٠ جار)
	٢	ڕۆشتن بە درێژایی ژورەکە (١٠ جار بە چاوکراوەیی و ١٠ جار بە داخراوەیی)
	٣	ڕۆشتن بەرەو نزمایی و بەرزایی لە شوێنێکی لێژدا (١٠ جار بە چاوکراوەیی و ١٠ جار بە داخراوەیی)
	٤	ڕۆشتنی بەرەو بەرزی و بەرەو نزمی بەسەر پلیکانەدا (١٠ جار بە چاوکراوەیی و ١٠ جار بە داخراوەیی)
	٥	ڕاهێنانی وەرزشی تر کە خۆ نوشتانەوە و خۆ کشانی تێدا بێ وەکو تۆپی سەبەتە
ئەم ڕاهێنانانە پێویستی بە هەوڵ و کۆشش هەیە. تا ڕاهێنانەکان بە شێوەیەکی ڕاست و دروست و لە کاتی خۆیدا ئەنجام بدرێت نەخۆش خێراتر و بە شێوەیەکی باشتر بەرەو چاکبونەوە دەروات.		

Appendix 21. Email shows permission from the original developer to use optokinetic training videos.

Fwd: Gabrielle Pierce

Inbox x

sherko fathullah <sherko.fathullah@univsul.edu.iq> Thu, May 3, 2018, 8:46 PM

to me

---------- Forwarded message ----------
From: **Gabby** <gabriellemariepierce@live.com>
Date: Thu, May 3, 2018 at 8:20 PM
Subject: Re: Gabrielle Pierce
To: "sherko.fathullah@univsul.edu.iq" <sherko.fathullah@univsul.edu.iq>

Hello Dr. Zmnako,
I am so sorry about being unable to contact me. You have my permission to use my videos.

Would love to hear more about your research,
Gabrielle Pierce, DPT

Sent from my iPhone

On May 3, 2018, at 12:43 PM, Daniel DiPaola <danieljdipaola@gmail.com> wrote:

6.3 Kurdish abstracts

عێراق – هەرێمی کوردستان
وەزارەتی خوێندنی باڵا و توێژینەوەی زانستی
زانکۆی سلێمانی – کۆلێجی پزیشکی
بەشی نەشتەرگەری

نرخاندن و شایستەکردنەوەی فێستیبیول لەو نەخۆشانەی کە توشی شێواوی فێستیبیولی چێوەیی یەکلا بون

دکتۆرانامەیەکە پێشکەش کراوە بە ئەنجومەنی کۆلێجی پزیشکی - زانکۆی سلێمانی
وەک بەشێک لە پێداویستیەکانی بە دەستهێنانی بڕوانامەی دکتۆرا
لە نەخۆشی و نەشتەرگەری قوڕگ و لوت و گوێ دا

لە لایەن
شێرکۆ سعید فتح الله زمناکۆ
بەکالۆریۆس لە هەناوی و نەشتەرگەری گشتی - دبلۆمی باڵا (ماستەر)
لە نەخۆشی و نەشتەرگەری قوڕگ و لوت و گوێ دا
کۆلێجی پزیشکی-زانکۆی سلێمانی و سەنتەری سلێمانی فێرکاری بۆ
نەخۆشی و نەشتەرگەری قوڕگ و لوت و گوێ وسەر و مل

بە سەرپەرشتی
پرۆفیسۆری یاریدەدەر یوسف ابراهیم چلبی
دبلۆمی باڵا، بۆردی عێراقی، و بۆردی عەرەبی - نەخۆشی و نەشتەرگەری قوڕگ و لوت و گوێ

ئۆکتۆبەر ٢٠١٩ زایینی ڕەزبەر ٢٧١٩ کوردی سەفەر ١٤٤١ هیجری

توێژینەوەی یەکەم

پشت پێ بەستویی، و ڕەوایەتی لە فێرژنی کوردی (دایلێکتی ناوەڕاست) ئاماری کۆسپەکانی گێژبون دا

پوختە

پاشخانی زانستی

شێواوی لە ڤێستیبیول دا دۆخێکی تەندروستی باوە و دەبێتە هۆی دروستکردنی تەنگوچەڵەمەی تەندروستی و دارایی.
نرخاندنی کلینیکی ئەم شێواویانە ئەستەمە، چونکە سکاڵاو دەرەنجامەکانیان ناڕون و خۆییە کە ئەستەمە لێکۆڵینەوە و نرخاندنیان بۆ بکرێت.
ئاماری کۆسپەکانی گێژبون (Dizziness Handicap Inventory [DHI]) ئامڕازێکە کە بەهۆیەوە نەخۆشی توشبو بە شێواوی ڤێستیبیول دەتوانێت دەرەنجامەکانی نەخۆشییەکەی خۆی بنرخێنێت. بۆیە بە شێوەیەکی بەربڵاو بەکارهێنراوە لە بواری ڤێستیبیول دا. ئەم ئامڕازە دەتوانێت لە ڕێگای سێ لقە پێوەر و پێوەرێکی سەرەکییەوە نرخاندن بکات ، یەک لەدوای یەک، بۆ سێ کاریگەری و کۆی گاریگەرییەکان کە ئەم شێواویانە دروستی دەکەن لە سەر نەخۆشەکان؛ ئەوانیش: ١ - کاریگەری فیزیکی (DHI-Physical) ٢ - کاریگەری هەڵچونی (DHI-Emotional) ٣- کاریگەری کارئەندامی (چالاکی) (DHI-Functional) و ٤ - کۆی هەرسێکیان کە دەبێتە کۆی پێوەراکان (DHI-Total).

مەبەست

مەبەست لەم توێژینەوەیە بریتی بو لە گونجاندنی کلتوری ئاماری کۆسپەکانی گێژبون بۆ زمانی کوردی (دایلێکتی ناوەڕاست) و سەلماندنی ئەوەی کە ئەم ئامرازە بە زمانی کوردی شایانی پشت پێ بەستنە و خاوەنی ڕەوایەتیە

ڕێگاکان

توێژینەوەیەکی پانەڕگەیی ئەنجام درا بۆ پێوانە کردنی کاریگەریەکانی شێواویەکانی ڤێستیبیول. هاوکات لەگەڵ ڤیرژنە کوردییەکەی ئاماری کۆسپەکانی گێژبون، دوو ئامڕازی تر کە توانای پێوانەکردنی دەرەنجامەکانیان هەبو بەکارهێنران وەک بەراوردکار ؛ ئەوانیش بریتیبون لە

١ پێوەری ئانالۆگی بینەیی (Visual Analogue Scale)

٢ تاقیکردنەوەی کلینیکی بۆکارلێکردنە هەستیاریەکان و هاوسەنگی (Clinical Test of Sensory Interaction and Balance)

پشکنین کرا بۆ پشت پێ بەستویی دەرەکی لە ڕێگای هاوپەیوەندی هاوکۆلکەی ئینتراکلاسەوە intraclass correlation [ICC] coefficient

پشکنین کرا بۆ پشت پێ بەستویی ناوەکی لە ڕێگای کرۆنباخی ئەلفاوە (Chronbach’s Alpha)

ئەنجامەکان

کۆی نەخۆشەکانە بەشداربوەکان (ژ 301 = ، تێکڕای تەمەن = 44.5 ± 15.2; مێ 59.8٪)، گشتیان بەلایەنی کەمەوە بۆ ماوەی مانگیک سکاڵای ڤێستیبیولیان هەبو، لەگەڵ ئەم نەخۆشانە بەشداربوی تەندروستیش بەشداریکرد (ژ 43 = ، تێکڕای تەمەن = 42 ± 17.9; مێ 62.8٪)(ژمارەی گشتی = 344). پشت پێ بەستویی دەرەکی و ناوەکی پێوەری سەرەکی و سێ ژێرپێوەرەکانی ئەم ئامڕازە لە ئاستێکی باشەوە تا نایابی نیشاندا؛ بە پێی ئەو ڕیزەی سەرەوە ئاستی پشت پێبەستویی دەرەکی ژێرپێوەرەکان و پێوەری سەرەکی، بەم شێوەیە بو 0.88، 0.91، 0.92، و 0.93؛ و پشت پێ بەستویی ناوەکی بەم شێوەیە بو 0.71، 0.75، 0.73، و 0.87 .

دەرەنجام

ئاماری کۆسپەکانی گێژبون وەرگێردرا بۆ دایلێکتی ناوەڕاستی زمانی کوردی، پاشان گونجێنرا لەگەڵ کلتوری کوردیدا. تاقیکردنەوە ئاماریەکان سەلماندیان کە ئەم ئامڕازە دەتوانرێت پشتی پێ ببەسترێت و ڕەوایەتی هەیە. بۆیە تەندروستکاران و توێژەرەکان دەتوانن بەکاریبهێنن بۆ نرخاندنی کاریگەریەکانی شێواویەکانی ڤێستیبیول لەو دانیشتوانەی کە بەزمانی کوردی دەدوێن.

توێژینەوەی دووەم

گونجاندنی کلتوری، پشت پێ بەستویی، و ڕەوایەتی لە پێوەری سکاڵای سەرەخولێ- فۆرمی کورت بە زمانی کوردی (دایلێکتی ناوەڕاست)

پوختە

پاشخانی زانستی

سکاڵاکانی ڤێستیبیول ئاڵۆزن، ئەستەمە بۆ نەخۆش پێناسەیان بکات و بۆ تەندروستکار بیانترخێنێت. پێوانە کردنی دەرەنجامەکانی نەخۆشی لە لایەن نەخۆشەوە ([patient-reported outcome measures [PROMs) بوەتە ئامڕازێکی باو و پەسەند لەبواری نەخۆشیەکانی ڤێستیبیول دا، بە تایبەتی ئەگەر پشت پێ بەستو بێت و خاوەنی ڕەوایەتی بێت. بە پێی باشترین زانیاری کە لەبەردەستە، ئەم شێوە ئامڕازانە بە زمانی کوردی بونیان نییە.

مەبەست

مەبەست لە ئەنجامدانی ئەم توێژینەوەیە بریتی بو لە وەرگێڕانی پێوەری سکاڵای سەرەخولێ - فۆرمی کورت ([Vertigo Symptom Scale-Short form [VSS-SF) بۆ زمانی کوردی (دایلێکتی ناوەڕاست) (VSS-SF-CK) و گونجاندنی کلتوری بۆی. هەروەها هەڵسەنگاندنی تایبەتمەندیەکانی پێوانەی دەرونی لەم ئامڕازەدا.

ڕێگاکان

لە پێناو بەرهەم هێنانی VSS-SF-CK توێژینەوەکە زۆر بەوردی پەیڕەوی ڕێنماییە نێودەوڵەتیەکانی کرد کە تایبەت بون بە پرۆسەی وەرگێڕان و گونجاندنی کلتوری. هەروەها لە ڕێگای تاقیکردنەوەی ئاماری پێویست زۆربەی تایبەتمەندیەکان کە پەیوەست بون بە پێوانە دەرونیەکان خرانە بەر تاقیکردنەوە. لەبەر ئەوەی داتاکان بە شێوەیەکی یاسایی بڵاو نەبون، دوو ڕێگا بەکارهێنران بۆ هەڵسەنگاندنی پێکهاتەی ئامڕازەکە ؛ ئەوانیش:

principal axis factoring و polychoric correlation .

بۆ تاقیکردنەوەی پشت پێ بەستویی دەرەکی و ناوەکی ئەلفای کرۆنباخ (Cronbach’s alpha) بەکارهێنرا. بۆ زانینی ڕەوایی ئامڕازەکە.

بۆ جیاکاری ناوەکی, ڕێژەی heterotrait–monotrait ratio of correlations (HTMT.85) بەکارهێنرا.

پشکنین کرا بۆ ڕەوایی نزیکبونەوە کاتیک پێوەرەکانی ئامڕازەکە بەراورد کرا لەگەڵ دوو ئامڕازی تردا کە بەکارهێنرابون بۆ ئەو مەبەستە.

ئەنجامەکان

بەشداربوان ژمارەیان 195 بو کە سکاڵاکانی ڤێستیبیول یا ن هەبو(تێکڕای تەمەن = 45 ± 15.8; مێ 56.4٪)، لەگەڵ ئەمانەشدا 30 بەشداربوی تەندروست وەک کۆنترۆڵ بەشداریان کرد (تێکڕای تەمەن = 35 ± 18.6; مێ 60٪).

پابەند بە ڕێگای ئاماری گونجاو، دەرکەوت پێکهاتەکانی (15 سکاڵا) ئەم ئامڕازە دەکەونە ژێر گاریگەری دو فاکتەرەوە: ڤێستیبیول (VSS-V) و خۆبزوێن-دڵەڕاوکێ (VSS-AA)، کۆی هەردوکیانیش دەکاتە پێوەری سەرەکی (VSS-T).

ئەلفای کرۆنباخی دو ژێرپێوەر و پێوەری سەرەکی، بەپێی ئەو ڕیزەی لە سەرەوە نوسراوە بەم شێوەیە بو: 0.81، 0.81، و 0.87.

ڕەوایەتی جیاکردنەوەی ناوەکی سەلمێنرا چونکە HTMT.85 کەمتر بو لە 0.85 .

هاوکۆڵکەی سپیرمان (Spearsman’s correlation) سەلماندی کە ئەم ئامڕازە ڕەوایەتی نزیکبونەوەی هەیە.

هاوپەیوەندی هاوکۆڵکەی ئینتراکلاس ([intraclass correlation coefficient [ICC) دەریخست کە ئامڕازەکە پشت پێ بەستویی دەرەکی نایابە بەم شێوەیە: بە پێی ڕیزەکەی سەرەوە 0.93، 0.94، 0.97.

دەرئەنجام

بەهۆی نەبونی ئامڕازی پێوانە کردنی دەرەنجامەکانی نەخۆشی لە لایەن نەخۆشەوە (PROMs) لە بواری ڤێستیبیول دا، ئەم توێژینەوەیە هەڵسا بە بەرهەمهێنانی پێوەری سکاڵای سەرەخولێ- فۆرمی کورت. تاقیکردنەوە ئاماریەکان پشتگیری ئەوەیان کرد کە ئامڕازی وەرگێڕدراو پێکهاتەیەکی تۆندوتۆلی هەیە، لە بوارەکانی دەرەوە و ناوەوە دەتوانرێت پشتی پێ ببەسترێت. بۆیە پزیشکان و توێژەرەکان دەتوانن بەکاریبهێنن بۆ نرخاندنی سلاڵاکانی شێواویەکانی ڤێستیبیول لەو دانیشتوانەی کە بەزمانی کوردی دایلێکتی ناوەڕاست دەدوێن.

تویژینەوەی سێیەم

مەشقی بینناییە جوڵە بە قیدیۆ لە شایستەکردنەوەی نەخۆشەکانی توشبو بە شێواویەکانی قێستیبیولی چێوەیی یەکلا، لە پارێزگای سلێمانی، عێراق

پوختە

پاشخانی زانستی

تێکردنە داتای قێستیبیول ڕو لە کەمی دەکات کاتێک نەخۆش توشی شێواوی درێژخایانی قێستیبیول دەبێت؛ بۆیە، ئەم نەخۆشانە ناچار دەبن بۆ ڕاگرتنی هاوسەنگی جەستەیان بە شێوەیەکی سەرەکی پشت ببەستن بە تێکردنە داتای بینایی (بینناییە پشتبەستن [visual dependency]). بەڵام، ئەم نەخۆشانە لە دەوروبەری دیمەن دژواردا (visually conflicted environment) هاوسەنگییان کەم دەبێتەوە.

مەشقی بینناییە جوڵە (optokinetic training) پاڵنەرە بۆ خۆڕاهێنانەوە و چالاک کردنی قێستیبیول لەم دۆخەدا و بە هۆیەوە سکاڵاکان کەم دەبنەوە و هاوسەنگی کارامەتر دەبێت.

مەبەست

مەبەستی سەرەکی ئەم تویژینەوەیە بریتی بو لە نرخاندنی گاریگەری مەشقی بینناییە جوڵەی قیدیۆیی لەو نەخۆشانەی توشی شێواویەکانی درێژخایەنی قێستیبیولی چێوەیی یەکلا بون و بە دیمەنی دژوار توشی سکاڵاکانی قێستیبیول دەبن.

ڕێگاکان

تویژینەوەیەکی هەڕەمەکی بە کۆنترۆڵی جوتکوێرانە، لە دوو سەنتەری سەرەکی بیستن و هاوسەنگی هوە لە پارێزگای سلێمانی 122 نەخۆشی ناونوس کرد. بەشێوەیەکی هەڕەمەکی ئەم نەخۆشانە دابەشکران بەسەر دو شێوە چارەسەردا.

١ گرۆپی کۆنترۆڵ (ژ 57، تێکڕای تەمەن 41.3 ساڵ ± 12.1 ؛ 54٪ مێ).

٢ گروپی تاقیکردنەوە (ژ 65، تێکڕای تەمەن 40 ساڵ ± 12 ؛ 53٪ مێ).

لە پێنج هەفتەی یەکەمدا هەردو گروپ مەشقی دەستکاریکراوی کوکسی-کاوثۆرنیان پیادەکرد؛ هاوکات لەگەڵ ئەمەدا، گرۆپی تاوقیکردنەوە مەشقێکی ئامادەکراوی بینناییە جوڵەی لەڕێگای قیدیۆە پیادە کرد.

لە پێنج هەفتەی دووەمدا، گروپی کۆنترۆڵ هەر بەردەوام بو لە سەر مەشقی دەستکاریکراوی کوکسی-کاوثۆرن؛ بەڵام، هەمان مەشقی بینناییە جوڵەی قیدیۆیی مان بۆ زیادکرد، هەرچی گروپی یاقیکردنەوەش بو بەدەر لە چالاکی ڕۆژانە ڕێنمایی کرا کەهیچ یەک لە مەشقەکان پیادە نەکات لر پێنگ هەفتەی دووەمدا.

بۆ نرخاندنی سکاڵاکان و کاریگەریەکان پێش مەشقەکان، دوای پێنج هەفتە، و دوای دە هەفتە لە مەشقەکان، سێ پێوەری سەرەکی بۆ دەرەنجامی نەخۆشی بەکارهێنرا, ئەوانیش: پێوەری بینناییە پشتبەستن (VDM)، پێوەری ئانالۆگی بینایی سەرەخولێی (VVAS)، تاقیکردنەوەی کلینیکی بۆکارلێکردنە هەستیاریەکان و هاوسەنگی (CTSIB)، ئاماری کۆسپەکانی گێژبون (قێرژنی کوردی) (DHI-CK)، و پێوەری سکاڵای سەرەخولێ – فۆرمی کورت (قێرژنی کوردی) (VSS-SF-CK).

ئەنجامەکان

بۆ زانینی سەرکەوتویی پرۆسەی هەڕەمەکییە دابەشکردن، گۆڕدراوە بەناو و ژمارییەکان تاقیکرانەوە؛ تاقیکردنەوەی نمونە سەربەخۆکان دەریخست کە هەردو گرۆپەکە سەر بە هەمان دانشتوانن و هیچکام لە گۆڕدراوەکان پشتنابەستن بە یەکێک لە گروپەکان چونکە بەهای ($P < 0.5$) .پیادەکردنی مەشقی قیدیۆیی بینناییە جوڵە بۆ ماوەی پێنج هەفتە کارییگەری بە بایەخی هەبو لە کەمکردنەوەی خاڵەکانی گشت پێوەرەکان (سەرەکی و یاریدەدەر)، بەهای ($P < 0.5$).؛ بەڵام، قەبارەی کاریگەریی (Effect size [ES]) بچوک بو. پێکەوە پیادەکردنی مەشقی دەستکاریکراوی کوکسی-کاوثۆرن و مەشقی قیدیۆیی بینناییە جوڵە بۆ ماوەی دە هەفتە بە شێوەیەکی بەرچاو خاڵی گشت پێوەرەکانی بەرەوکەمی برد ($P < 0.5, ES < 0.3$)

دەرەنجام

بۆ ئەونەخۆشانەی کە توشی شێواوی درێژخایانی قێستیبیول دەبن دیاردەی بینناییە پشت بەستنیان هەیە، پیادەکردنی مەشقی قیدیۆیی بینناییە جوڵە بۆ ماوەی پێنج هەفتە پرۆتۆکۆلێکی کارامەیە لە کەمکردنەوەی دیاردەی بینناییە پشتبەستن. ئەم مەشقە، دەبێتە هۆی کەمبونەوەی سکاڵاکانی قێستیبیول و سکاڵا پاشکۆکانیان وەک سکاڵاکانی خۆبزوێن – دڵەڕاوکی. هەروەها، کاریگەریە نەخوازراوەکانی فیزیکی، هەڵچونی، و چالاکی کەمدەکاتەوە؛ دوایین، هاوسەنگی لە دەوروبەری دیمەن دژواردا باشتردەکات.

6.4 Arabic abstracts

البحث الاول

موثوقية وصلاحية النسخة الكردية (اللهجة الوسطى) للمخزون العوقي للدوخة

الخلاصة

الخلفية العلمية

تعتبر اضطرابات الدهليز (Vestibular disorders) حالة مرضية شائعة ترتبط معها مشاكل صحية وتترتب عليها تكاليف مادية. ويشكل تقييم هذه الاضطرابات تحديا، لأن أعراضها وتبعاتها غير دقيقة، غامضة، وشخصية (ذاتية)؛ بحيث انه من الصعب وصفها من قبل المريض وقياسها من قبل الكادر الصحي.

ان مقياس المخزون العوقي للدوخة (Dizziness Handicap Inventory [DHI]) هو مقياس واسع الاستخدام في المجال الدهليزي، وقد أثبتت موثوقيته وصلاحيته عند اجراء التكييف الثقافي له بكثير من اللغات العالمية.

الأهداف

ترجمة المخزون العوقي للدوخة وتكييفه ثقافيا في اطار اللغة الكردية (اللهجة الوسطى) (DHI-CK)، وجرى التحقق من موثوقيته وصلاحيته.

الطرق

دراسة مقطعية استخدمت لقياس الاختلالات التوازنية الدهليزية بتطبيق النسخة الكردية للمخزون العوقي للدوخة (DHI-CK) وتم استخدام المقياسين الآتيين للمقارنة :

١ مقياس التناظرية البصرية (Visual Analogue Scale [VAS])

٢ مقياس الفحص السريري للتفاعلات الحسية والتوازن (Clinical Test of Sensory Interaction and Balance [CTSIB])

وقد جرى فحص الموثوقية الخارجية والداخلية عن طريق معامل ارتباط انتراكلاس (Intraclass Correlation Coefficient [ICC]) ومعامل كرونباخ ألفا (Chronbach's Alpha)، على التوالي.

النتائج

عدد المرضى 301 (معدل متوسط العمر 44.5 ± 15.2 سنة؛ الأناث 59.8٪) وقد عانوا من الأعراض الدهليزية لمدة 30 يوما على الاقل، حيث تم تشخيصهم كمرضى الدهليز. اما عدد المشاركين السالمين (غير المرضى) فكان عددهم 43 (معدل متوسط العمر 42 ± 17.9 سنة؛ الأناث 62.8٪. العدد الكلي= 344).

اظهرت النسخة الكردية للمخزون العوقي للدوخة (DHI-Total) ومقاييسه الفرعية الثلاثة: المقياس الفيزيائي (DHI-Physical)، والمقياس العاطفي (DHI-Emotional)، والمقياس الوظيفي (DHI-Functional)، الموثوقية الخارجية من جيد الى ممتاز، حيث ان نتائج الاختبار واعادة الاختبار لـ ICC كانت: 0.93, 0.88 ، 0.91، و 0.92 على التوالي. اما الموثوقية الداخلية عن طريق معامل ألفا فقد كانت: 0.87، 0.71، 0.75، و 0.73 على التوالي.

وجرى فحص الصلاحية المتقاربة بواسطة ترابط سبيرمان (Spearman' s correlation) بين DHI-CK والمقياسين VAS و CTSIB. وتم اثبات صلاحية التمايز عن طريق أختبار U لمان-ويتني والتحليل الدالي العملي الخصائصي المستلم (receiver operating characteristic curve analysis).

الاستنتاج

اثبتت النسخة الكردية للمخزون العوقي للدوخة موثوقيتها الخارجية والداخلية. وتميزت النسخة بصلاحيتي التقارب والتمايز. وظهر أنها وسيلة ذات صلاحية ومعتمدة يمكن أستخدامها من قبل الكوادر الصحية والباحثين لقياس التأثيرات المتعددة لاضطرابات دهليز التوازن بين السكان الناطقين بالكردية (اللهجة الوسطى).

البحث الثانى

التكييف الثقافي، الموثوقية، وصلاحية مقياس عرض الدوار – الصيغة القصيرة (VSS-SF) في اللغة الكردية (اللهجة الوسطى)

الخلاصة

الخلفية العلمية

تعتبر الاعراض الجوهرية لدهليز التوازن غامضة ومن الصعب وصفها من قبل المرضى وتحديدها كميا من قبل الأطباء. لقد أصبح مقياس نتائج المرض المدون من قبل المرضى الذين استحصلوا على الموثوقية والصلاحية وسيلة مقبولة وشائعة الأستعمال في التخصص الدهليزي. ولوحظ ان اللغة الكردية تفتقر الى هذه المقاييس بصورة تامة.

الهدف

يكمن هدف هذه الدراسة الاستقصائية في تقييم الخصائص النفسية القياسية للنسخة الكردية من مقياس عرض الدوار – الصيغة القصيرة (VSS-SF-CK).

الطرائق

لجأت الدراسة الى استخدام عملية منظمة حسب المعايير الدولية للترجمة والتكييف الثقافي لاستخراج الصيغة الكردية من مقياس عرض الدوار – الصيغة القصيرة. تم اختيار دراسة مقطعية لتقييم خصائصها القياسية النفسية. وبسبب التوزيع غير الطبيعي لنتائج المتغيرات، تم استخدام كلا مبدأي العوامل المحورية والترابط المتعدد الألوان لاختبار التركيب. تم تثمين الثبات الداخلي للمقاييس باستخدام معامل ألفا والموثوقية المركبة. كما جرى تثمين الصلاحية التمييزية باستخدام نسبية الميزة المتغيرة-الميزة الاحادية ($HTMT_{.85}$) ومعيار فورنيل-لاركر الترابطية. ولغرض اختبار الصلاحية المتقاربة جرى استخدام ترابط سبرمان، وقورنت الوسيلة بوسيلتين تم تعيينهما واستخدامهما لغرض المقارنة.

النتائج

عدد المشاركين في البحث 195، يتكونون من 165 مريض يشكون من أعراض الدهليز (معدل العمر 45 ± 15.8؛ الأناث 56.4٪) و 30 مشارك طبيعي بدون مرض (معدل العمر ٣٥ ± 18.6؛ الاناث 60٪).

استنادا الى المخطط الأساس مع الطرق المتعلقة الأخرى مثل التحليل الموازي لهورن والمعدل الأدنى الجزئي تم استخراج عاملين: الدهليزي (VSS-V) والذاتى-القلقي (VSS-AA). أظهرت كل من هذين العاملين تركيبة قوية عن طريق تحميل القوي لموادهما وتحميل الضعيف لمواد الآخر.

كانت الموثوقية الداخلية لكلا العاملين وكذلك للمعدل الكلي للعاملين (VSS-T) جيدة جدا، وكانت معامل ألفا على التوالي 0.81، 0.81، و 0.87. أثبتت الصلاحية التميزية وكانت قيمة $HTMT_{.85}$ أقل من 0.85 (0.71). العلاقة الترابطية لسپرمانز اسندت نظرية الدراسة واكدت الصلاحية التقاربية. معامل الترابط التداخلي اظهرت الموثوقية الخارجية لكلا العاملين والمعدل الكلي، وقيمة الاختبار واعادة الاختبار على التوالي كانت 0.93، 0.94، و 0.97.

الاستنتاج

مع الأخذ بنظر الاعتبار النقص الخطير في مقياس نتائج المرض المدون من قبل المرضى في حقل الدهليز باللغة الكردية؛ تم التكييف الثقافي الكردي وتثمين الصفات النفسية القياسية لمقياس عرض الدوار – الصيغة القصيرة. كانت النتائج مشجعة وواعدة، لأنها أظهرت تناسقا خارجيا وصلاحية التكوين. جودة تناسب المؤشرات أظهرت أن النسخة الكردية لمقياس عرض الدوار – الصيغة القصيرة- موثوقة، معتمدة، وذات صلاحية بحيث يمكن استخدامها من قبل الأطباء السريرين والباحثين بين السكان الناطقين باللغة الكردية (اللهجة الوسطى).

البحث الثالث

التدريب البصري الحركي بالفيديو في تأهيل مرضى اضطرابات الدهليز المحيطي الأحادي الجانب في محافظة السليمانية- العراق

الخلاصة

الخلفية العلمية

تتضاءل مساهمة الدهليز في بقاء التوازن بين المرضى المصابين باضطرابات مزمنة للدهليز، وعليه، يزداد اعتماد المريض على المساهمة البصرية. لذلك فإنهم يعانون من أعراض الدهليز والاختلال في التوازن (المحفز من قبل البصر) في المحيط المتأزم بصريا. ويزيد التحفيز البصري من وتيرة التكييف الدهليزي ويؤدي الى انخفاض الاعتماد البصري، وباتالي يقلل الأعراض ويحسن الاستقرار والتوازن.

الأهداف

الهدف الاساسي لهذه المحاولة هو لتقييم كفاءة بروتوكول التدريب البصري الحركي بالفيديو على مرضى اضطرابات الدهليز المحيطي الأحادي الجانب المزمن والذين يعانون من أعراض الدهليز المحفز بصريا.

الطرق

استخدمت الدراسة طريقة المزدوج غير المنظور العشوائي المحكوم لتحشيد المشاركين بالبحث في مركزين رئيسيين للسمع والتوازن. عدد المشاركين 122، تم توزيعهم بشكل عشوائي الى مجموعتين: 57 في مجموعة التحكم (معدل العمر 41.3 ± 12.1؛ الأناث 54٪) و65 في مجموعة التجربة (معدل العمر40 ± 12؛ الأناث 53٪). وقد اخضعت كلتا المجموعتين في الأسابيع الخمسة الأولى لبروتوكول تدريب كوكسى-كاوثورن المعدل (MCP)، واضافة الى هذا البروتوكول، تم أخضاع مجموعة التجربة لبروتوكول ثان وهو بروتوكول التدريب البصري الحركي بالفيديو (VOP). وفي الأسابيع الخمسة التالية، استمرت مجموعة التحكم في الخضوع لـ MCP مع اضافة VOP. وجرى بالتزامن نصح مجموعة التجربة بعدم مزاولة أي بروتوكول. استعملت ثلاثة مقاييس اساسية للنتائج، أى: مقياس الأعتماد البصري (VDM)، مقياس الدوار البصري التناظري (VVAS)، والفحص السريري للتفاعلات الحسية والتوازن (CTSIB) ومقياسين ثانويين للنتائج. تم استخدام المقاييس الخمسة لقياس نتائج المرض والتغييرات الحاصلة في الحالة الصحية في ثلاثة أوقات؛ أي، قبل بدء البروتوكولات (الاساس)، بعد خمسة الاسابيع الاولى، وبعد خمسة الاسابيع الثانية.

النتائج

تم فحص المتغيرات الاسمية والرقمية الاساسية لبيان مدى نجاح العملية العشوائية. اظهرت تجربة النماذج غير المعتمدة أن كلتا المجموعتين تعودان الى المجموع السكاني نفسه، ولم يكن هناك اي متغير يعتمد على أية مجموعة (نسبة إحتمالية p أكثر من 0.05). وادى تطبيق بروتوكول التدريب البصري الحركي بالفيديو لمدة خمسة اسابيع الى انخفاض تدرج كل المقاييس الخمسة بكفاءة (نسبة احتمالية p أقل من 0.05)؛ ولكن حجم التاثير ES كان قليلا (ES أقل من 0.3) . ان التطبيق المشترك لكلا البروتوكولين لمدة خمسة اسابيع كان له تاثير جوهري في تضاؤل تدرج المقاييس الخمسة في كلتا المجموعتين. حيث ان تجربة النماذج المعتمدة اظهرت نسبة إحتمالية p أقل من 0.05؛ ES أكثر من 0.3.

الاستنتاج

لقد تبينت كفاءة بروتوكول التدريب البصري الحركي بالفيديو في تخفيض الاعتماد البصري بين مرضى اضطرابات الدهليز المحيطي الأحادي الجانب المزمن. إن هذا البروتوكول يخفض الأعراض الدهليزية والأعراض الذاتية-القلقية. ويؤدي بالاضافة الى ذلك الى تقليل التأثير الفيزيائي، العاطفي، والوظيفي لهذه الأضطرابات. وأخيرا، فإنه يحسن التوازن في المحيط المتازم بصريا؛ ولكن حجم التأثير يكون أكثر بكثير عندما يطبق كلا البروتوكولين معا (MCP وVOP) ولمدة خمسة اسابيع.

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فرع الجراحة

التقييم والتأهيل الدهليزي للمرضى المصابين باضطرابات الدهليز المحيطي الاحادي الجانب

اطروحة مقدمة الى مجلس كلية الطب - جامعة السليمانية
كجزء من متطلبات نيل شهادة الدكتوراه
في امراض وجراحة الأنف
والأذن والحنجرة

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تشرين أول ٢٠١٩ م رەزبەر ٢٧١٩ ک صفر ١٤٤١هـ