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Original Article

The Reliability and Validity of "Dokuz Eylül University Meniere's Disease Disability Scale"

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OBJECTIVE: Ménière's Disease (MD) is a chronic, non-life threatening inner ear disease, with attacks of disabling vertigo, progressive hearing loss, and tinnitus as the major symptoms. All three symptoms, separately or in combination, cause great distress and have a considerable impact on the quality of life of the patients. The aims of this study were to develop a disease-specific quality of life survey for patients with MD and to analyze the relationships between the audiovestibular findings and the survey.

MATERIALS and METHODS: Following Ear-Nose-Throat examination and audiovestibular tests, the Dokuz Eylül University Meniere's Disease Disability Scale (DEU-MDDS) and Turkish version of the Dizziness Handicap Inventory (DHI-T) were administered to 93 patients with definite MD. Reliability and validity analyses of the scale were performed.

RESULTS: There were 45 (48.4%) male and 48 (51.6%) female patients and the mean age was 48.9±12.1 years. Cronbach's alpha was 0.92 and intraclass correlation coefficients of the DEU-MMDS were significant ($p<0.001$). Results of the Goodness of Fit Statistics showed that the expression levels of the items were high and the correlation coefficients of each item with the scale were sufficient. There was a statistically significant correlation between DHI-T scores and MDDS. DEU-MDDS was not related to the vestibular tests, age or gender ($p>0.05$).

CONCLUSION: The MDDS is a valid and reliable scale as a disease-specific quality of life questionnaire for patients with MD.

KEYWORDS: Meniere's disease, vertigo, quality of life, hearing loss

INTRODUCTION

Meniere's disease (MD) is an idiopathic syndrome characterized by endolymphatic hydrops. Vertigo attacks are accompanied by hearing loss, tinnitus, and fullness in the pathological ear [1-3]. Vertigo is the major symptoms and their effect on balance function is a key concern for patients, which may affect their daily functions negatively. Although MD is not regarded as life-threatening, most patients consider their condition as life-altering. The symptom complex can have a dramatic influence on a patient's quality of life [4, 5]. Quality of life (QoL) can be described as the subjective value placed on one's satisfaction with their life. It encompasses the patient's subjective perception of health, psychological status, social interactions, physical state, and functional abilities [6]. Studies regarding the use of QoL in identifying diseases, staging patients, and assessing the success of treatments found a rapidly increase in the recent years [5, 7, 8]. Since 1972, the Committee on Hearing and Equilibrium of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) has published three versions of the recommended guidelines for reporting results of MD treatment. In the last revision, a six-point functional level scale was added whereby the patients assess the effect of vertigo on their daily activities [9]. This scale can be considered as the first tool to evaluate QoL of the patients with MD. In recent years the use of QoL scales in MD patients has increased [6]. However, hearing loss, tinnitus, imbalance, and QoL were evaluated by different scales in most of these studies and general or field-specific scales were not specific to MD [8, 10]. MD differs from other otological conditions in terms of complaints about the hearing loss and vertigo attacks. Attack features and inter-episode conditions are also specific to the disease and the patient. Therefore, patients must be evaluated individually with a specially

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developed scale for MD. Disease-specific QoL scoring systems are very effective methods for also assessing a patient's perceived experience of a particular disease [7].

There are two MD-specific QoL surveys in the literature. The first one is the Meniere's Disease-Patient Oriented Severity Index (MD-POSI) [6, 11]. The other survey is the Meniere's Disease Outcome Questionnaire (MDOQ), which was generated by Kato et al. [12] in 2004. Neither has been widely used in the literature. Their structural validities have not been analyzed yet.

Based on this information, the first aim of this study was to develop an original QoL scale for MD patients. The other purpose was to evaluate the relationship between the survey and the audiovestibular features of the patients.

MATERIALS and METHODS

Between June 2014 and March 2015, 93 patients diagnosed as having definite MD according to the 1995 AAO-HNS criteria were included in the study conducted by our department of Otolaryngology Head and Neck Surgery, Hearing-Speech and Balance Unit. After a detailed medical and otological history, including clinical and familial characteristics, all patients underwent a detailed otological examination followed by audiovestibular investigations. The audiological tests were pure tone and speech audiometry, as well as acoustic immitance measurements. Pure tone and speech audiometry tests were performed using an Interacoustics AC-40™ device (Interacoustics A/S, Denmark), which is a two-channel audiometer in a double wall and a double suites audiometry booth. For audiometric results, Goodman's classification was accepted as the reference [13]. Acoustic immitance measurements were done using an Interacoustics AZ-7™ device (Interacoustics A/S, Denmark) and the findings were analyzed according to Jerger's classification [14].

Videonystagmographic (VNG) evaluation, bithermal caloric test, positional tests, and other tests such as head-shaking, clinical head impulse, Romberg's and sharpened Romberg's, Unterberger's stepping, and eyes open/closed tandem gait tests were performed. VNG evaluations were done with Vortex™ equipment (Visual Eyes™ Binocular goggles, FireWire 100 Hz, Eyemax™ Spectrum Balance Software; Micromedical Technologies, IL, USA). The test protocol included saccadic, tracking and optokinetic eye movement evaluations, and recordings of gaze and spontaneous nystagmus, as well as head-shaking nystagmus, bithermal caloric, and positional tests. For the bithermal caloric test, the maximum slow-phase velocity of nystagmus was calculated after each irrigation, and canal paresis and directional preponderance were determined according to Jongkees' formula. If the asymmetry between the responses for the left and right ears was > 21%, the result was considered to be indicative of significant canal paresis. For directional preponderance, a difference between the right and left beating nystagmus of > 28% was considered pathological. The caloric test was considered normal when both (canal paresis and directional preponderance) were within normal limits. Following audiovestibular assessments, the Dokuz Eylül University Meniere's Disease Disability Scale (DEU-MDDS) and the Turkish version of the Dizziness Handicap Inventory (DHI-T) were administered by an audiologist [15, 16].

The Dizziness Handicap Inventory (DHI) is the most widely used scale to assess the self-perceived handicapping effects imposed by vestibular system diseases. The patient answers "yes", "sometimes" or "no" to each question and the strength of the responses are designated with numeric values of 0, 2, and 4. The questionnaire has 25 items, such that the total score ranges from 0 to 100, with a higher score indicating a higher handicap [15].

The originally-developed DEU-MDDS, is an MD-specific QoL scale inspired by the characteristics, clinical course, and other features of MD, as well as a careful review of other scales developed previously for MD, along with other neuro-otological diseases. Since MD is a disease with acute disabling vertigo episodes (spells, attacks) and inter-episodic imbalance periods without attacks, those features needed to be assessed separately. For that reason, the scale consists of two factors; there are subscales for "acute episode" and "between the episodes," with 52 questions for each. The acute episode subscale includes 13 items about physical symptoms during attacks and includes 13 items. The between the episodes subscale includes 39 items assessing daily and self-care activities, restrictions on participation in social life and employment. The questionnaire was completed during patient interviews with the supervision of an audiologist. Each answer was taken on a scale between 1 and 5 (1: never and 5: always) according to the Likert scale technique [17]. Higher scores indicated a higher disability. Each sub-section score and the overall total score of the scale were calculated. Results of the survey were first calculated as a score and then the disability as a percent (Figure 1).

Exclusion criteria from the study were non-volunteering, a presence of an additional central nervous system pathology, an age under 18 or over 70, or a presence of congenital nystagmus or any other diseases that could lead to dysconjugate eye movements.

All numeric, ordinal, and nominal data were analyzed by using Statistical Package for Social Sciences version 20.0 (IBM Corp.; Armonk, NY, USA) and LISREL 8.8 (Latent Structural Relation Scientific Software International Inc, IL, USA) statistics softwares. The descriptive statistics (frequencies for nominal and ordinal values; means and standard deviations for scale values), correlation coefficients (Spearman's test), t-test, reliability tests (Cronbach's alpha, model fitting ANOVA, Tukey's Additivity test, Hotelling's T-square statistics, intraclass correlation coefficients, item-total correlation coefficients, corrected item-total correlation coefficients and Cronbach's alpha if item-deleted), face and content validities, exploratory factorial analyses (Varimax rotation with Kaiser normalization) and confirmatory factorial analyses (Goodness of Fit Statistics) were also completed. Face and content validities were measured by consulting with ten experts. The expert panel consisted of 3 otorhinolaryngologists, 5 audiologists (PhD), 1 occupational therapist (PhD), and 1 psychologist (MSc). Face validity is concerned with how appropriate, relevant, and clear the items on a questionnaire are concerning the aim of the scale. In order to assess content validity, the content validity ratio (CVR) and content validity index (CVI) were calculated. For calculating CVR, the expert panel was requested to comment independently on the necessity of each item using a 3-point Likert scale; 1=essential, 2=useful but not essential, and 3=unessential. Following the expert's assessments, a CVR for the total scale was computed. According to Lawshe's Minimum Value Table, an accept-

able CVR value for 10-expert panels is 0.62 or above [18]. For the CVI, the same expert panel was asked to evaluate the individual items (I-CVI: must be higher than 0.78, at 0.05 significance level) and the overall scale (S-CVI: must be higher than 0.80) according to a 4-point Likert scale (1=not relevant, 2=somewhat relevant, 3=quite relevant, and 4=highly relevant) on "relevancy," "clarity," and "simplicity" [19, 20]. CVI scores of DEU-MDDS were calculated by determining the proportion scores of 3 or 4 by all experts.

Reliability analyses are used to evaluate the reliability of instruments used for measurement. The basic assumption of the reliability analysis is that each question is a linear component of the total score. There must be an additivity feature in the scale. Tukey's Additivity test was performed to assess the additivity feature of DEU-MDDS. Whether the question averages are equal to each other were tested using Hotelling's T-square statistics.

For the test-retest reliability of the DEU-MDDS, a subsample of definite MD patients (n=20) completed the scale twice with a two-day interval in order to examine the stability of the DEU-MDDS by calculating intraclass correlation coefficients.

This study was approved by the local ethical committee (2014/22-41). All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all patients.

RESULTS

Forty-five (48.4%) patients were male, 48 (51.6%) were female and the mean age was 48.9±12.1 years. The mean duration of MD was 5.6±4.7 (min: 10 months; max: 14 years) years. Fourty-two cases were pathological in the right ear (n=42 patients, 45.2%), and in the left ear (n=45 patients, 48.4%). There were six (6.5%) bilateral cases. The mean attack time was 5.2±9.8 h. 40.9% of patients had one or more accompanying chronic diseases. The most common comorbidities were hypertension (8.6%), coronary artery disease (5.4%), thyroid related pathologies (5.4%), depression (3.2%), and hypertension plus diabetes mellitus (3.2%). The familial MD history was 8.6%. The description of at least one attack trigger was 77%; the highest values were stress (35.5%), stress plus seasonal changes (9.7%), seasonal changes only (5.4%), stress plus effort (4.3%), and stress plus sleepiness (3.2%). The audiological findings regarding patients with unilateral and bilateral MD are shown in Table 1. Degrees of hearing loss in the pathological ears were mild in 36.8%, moderate in 32.2%, moderately severe in 19.5%, severe in 9.2%, and profound in 2.3% of unilateral MD patients. Type A and As tympanogram were obtained in 89.7% of patients and acoustic reflexes were obtained in 78.2% of involved ears of unilateral cases. All of the bilateral MD cases had Type A and As tympanogram and acoustic reflexes were positive in 66.7%.

Gaze evoked nystagmus was not observed in any of the patients. Spontaneous nystagmus was recorded in 15 patients (16.1%). Head-shaking nystagmus was detected in 19 patients (20.4%). Pathological finding ratios of VNG tests were 1.1% for saccadic, 8.6% for tracking, and 14% for optokinetic eye movements. Findings of the bedside vestibular tests as the positivity percentage were (%): Romberg's: 3.2, sharpened Romberg's: 46.2, Unterberger's stepping: 44.1, eyes open tandem gait: 1.1, and eyes closed tandem gait: 48.4. The bithermal caloric test results were: normal: 40.9%, unilateral weakness (pathological side of unilateral MD): 55.9%, and bilateral weakness: 3.2%. Table 2 shows the Dizziness Handicap Inventory-Turkish Version (DHI-T) findings for MD patients.

Table 1. Pure tone and speech audiometry means and standard deviations of the patients with unilateral and bilateral Meniere's Disease (MD)

	Unilateral MD n=87		Bilateral MD n=6	
	Pathological ear	Healthy ear	Right ear	Left ear
Means of 0.5-2 kHz air conduction thresholds (dB HL)	46.8±21.4	15.6±13.9	58±14.4	46±14.7
Means of 0.5-3 kHz air conduction thresholds (dB HL)	47.4±22.3	18.8±15.1	54.8±19	49.5±21.4
Speech discrimination scores (%)	71.5±23.6	93.7±6.3	58.7±30	70.6±21.1

Table 2. Dizziness Handicap Inventory-Turkish version mean scores and standard deviations

	Mean Scores
Physical subscore (9 items)	15.93±8.91
Emotional subscore (7 items)	7.3±4.78
Functional subscore (9 items)	16.62±8.85
Total (25 items)	38.8±19.5

The CVR value was 0.99 and at the acceptable range (higher than 0.62). The CVI value of the DEU-MDDS was also 0.99. I-CVI and S-CVI values were 0.90 and 0.96, respectively. These CVI values were considered to demonstrate acceptable content validity. All 52 items of the DEU-MDDS had a CVI over 0.80; therefore, all items were retained.

The exploratory factorial loadings of DEU-MDDS were analyzed. The extraction method was principal component analysis and the rotation method was Varimax rotation with Kaisers' normalization. As a result of this analysis, 20 incompatible items (5 from the acute episode subscale and 15 from the between the episodes subscale) to the two-factorial structure were excluded from the scale (factorial loadings of these items were lower than 0.4). Thus, the number of DEU-MDDS items was decreased from 52 to 32. It was noticed that the excluded items had lower corrected item-total correlation coefficients and if item-deleted Cronbach's alpha values than the others. The new 32-item version of the DEU-MDDS was analyzed by exploratory factorial analysis again; it was shown that the DEU-MDDS had a two-componential factorial loading structure (Table 3).

The confirmatory factorial analyses were performed by the Goodness of Fit Statistics with the 32-item version of the scale. For the confirmatory factor analysis, chi-square (χ^2), Root Mean Square Error of approximation (RMSEA), Root Mean Square Residual (RMR), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) and Comparative Fit Index (CFI) were calculated. For statistical analysis values lower 5, above 0.6 and, being lower than 0.2 of values were

considered acceptable level for χ^2, GFI and AGFI, SRMR and RMSEA respectively for model data fitting [21-24]. The statistics on compliance of confirmatory factor analysis of the DEU-MDDS are given in Table 4. The compliance indexes obtained by confirmatory factor analysis of the structural models related to the DEU-MDDS show that there was a good agreement between the models and the data. The ratio of the chi-square value to the degree of freedom was 1.79, indicating a good compliance between the model and data. The levels of AGFI and GFI were above the 0.60 level and the CFI, NFI, and IFI values were higher than 0.80, also pointing to a sufficient fitting between the model and data. Being lower than 0.9, the SRMR value indicated that the model compatibility related to standardized errors of the model was a sign of the data fitting. It was noted that the RMSEA value covered a value of 0.08 within 90% probability. This also suggested that the model data alignment was sufficient [25]. It could be said that the generated DEU-MDDS model had a sufficient level of conformity with the data and structural validity when all of the model data compliance values for the scale were examined. For the Goodness of Fit Statistics, t-tests and R^2 (the model coefficients) calculations were also performed. It could be assumed that the items could measure the DEU-MDDS implicit variables. All t and standard values (chi-square=705.69, the degree of freedom=459, p<0.001, RMSEA=0.076) showed significant relations between both the implicit (DEU-MDDS) and the observed variables (each item of DEU-MDDS). These findings indicated that the definition levels of the items to implicit variables were high and the relations of item-scale were sufficient. R^2 values were higher than 0.1 except for items 7 and 8. As a result of all these analyses, the scale was simplified and the highest structural validity with the 32-item form was structured (Table 5).

Table 3. Factorial loadings of the 32 item Dokuz Eylül University Meniere's Disease Disability Scale

	Rotated Component Matrix	
	Components	
	1	2
AE4	0.701	
AE8	0.690	
AE2	0.666	
AE7	0.661	
AE3	0.630	
AE1	0.567	
AE10	0.483	
AE13	0.426	
BE32		0.792
BE33		0.790
BE34		0.755
BE30		0.753
BE35		0.724
BE17		0.718
BE19		0.708
BE18		0.707
BE14		0.703
BE4		0.686
BE7		0.654
BE23		0.639
BE38		0.637
BE5		0.619
BE37		0.618
BE1		0.591
BE2		0.591
BE24		0.584
BE11		0.561
BE13		0.539
BE12		0.539
BE22		0.519
BE39		0.496
BE3		0.456

AE: Items of the acute episode; BE: Items of between the episodes

The reliability of the internal consistency of the 32-item DEU-MDDS was measured with four indices; Cronbach's alpha (0.92), intraclass correlations (0.896, p=0.0001), Tukey's additivity test (p=0.0001, F=67.06, a=2.63, Grand mean=2.571), and Hotelling's T-square tests (p=0.0001, F=73.25). These values were deemed indicative of good reliability.

Table 6 shows the 32-item DEU-MDDS scores as means and disability as percent. The acute episode subscale mean score was 33.69±6.96 out of 40 points and the between the episodes subscale mean score was 58.35±21.47 out of 120 points. The total score was 92.06±24.54 out of 160 points.

A group of 20 MD patients (9 male, 11 female) ranging in age from 25 to 69 years (45.75±13.57 years) were administered the scale. Intraclass correlation-coefficients were computed for the total score, acute episode, and between episodes subscales of the 32-item DEU-MDDS. The test-retest reliabilities for the total score (r=0.899, df2=19, p<0.001), for the acute episode subscale (r=0.894, df2=19, p<0.001), and for the between the episodes subscale (r=0.899, df2=19, p<0.001) were good.

There were no relations between DEU-MDDS and age, gender, working status, duration of disease and degree of hearing loss. DEU-MDDS and DHI-T scores were evaluated in relation to each other and a significant relation was found between them (Table 7).

Table 4. The significance of the Goodness of Fit Statistics and prominent values

DEU-MDDS	χ2	df	NFI	RMSEA	SRMR	GFI	AGFI	CFI	IFI	90%CI
	827.7	461	0.84	0.084	0.087	0.66	0.61	0.92	0.92	0.073; 0.094

DEU-MDDS: Dokuz Eylül University Meniere's Disease Disability Scalte; χ2: Minimum Fit Function Chi-Square; df: degrees of freedom; NFI: Normed Fit Index; GFI: Goodness of Fit Index; AGFI: Adjusted Goodness of Fit Index; CFI: Comparative Fit Index; IFI: Incremental Fit Index; SRMR: Standardized Root Mean Square; RMSEA: Residual Root Mean Square Error of Approximation; 90%CI: 90 Percent Confidence Interval for RMSEA

Table 5. The 32 item Dokuz Eylül University Meniere's Disease Disability Scale

DURING THE ACUTE EPISODE					
During the acute episodes, I have	**1 Never**	**2 Rarely**	**3 Sometimes**	**4 Mostly**	**5 Always**
1. Increased hearing loss					
2. Tinnitus in my ear/head					
3. Noise in my ear/head					
4. Ear fullness					
5. Nausea					
6. Vomiting					
7. Sweating					
8. Sound sensitivity					
BETWEEN THE EPISODES					
Between the episodes, I have	**1 Never**	**2 Rarely**	**3 Sometimes**	**4 Mostly**	**5 Always**
1. Fear of having attacks when alone at home					
2. Fear of having attacks when at work or outside					
3. Sleeping problems					
4. A feeling of isolation or loneliness					
5. A feeling of weakness or depression					
6. Difficulty in bathing					
7. Limitations when walking at home					
8. Limitations when walking in the dark					
9. Limitations when walking outside					
10. Limitations when using public transportation					
11. Lifestyle changes					
12. A feeling like "My life will not be as good as before"					
13. A feeling like "I'm not a healthy person"					
14. Problems with family relations					
15. Limitations of my responsibilities to my family					
16. Limitations of work performance					
17. Limitations of outside responsibilities					
18. Limitations in social activities					
19. Limitations when shopping					
20. Limitations when doing home-care activities					
21. Limitations when doing physical exercises					
22. Attention problems					
23. A feeling of tired when reading					
24. Difficulties in concentration					

DISCUSSION

The main objective of the use of disease-specific QoL scales is to determine the effects of the disease on QoL. It is difficult to measure the effects of MD because the severity of the symptoms and the disease characteristics vary over time and from patient to patient. In our clinical practice, we have realized that previously reported vertigo and/or balance related QoL surveys are not completely compatible with MD characteristics. For MD, the questionnaire should be specific not only to the disease but also to the episodes and/or time between the episodes.

The AAO-HNS guide (1995) suggests the use of audiometric findings, number of attacks and the Functional Level Scale (FLS) for reporting the improvement of patients with MD. The FLS is the first example of a QoL measurement for this group. The sensitivity of the FLS to the physical and functional effects of MD is good but it cannot evaluate emotional and/or psychosocial situations [26].

There are two MD-specific QoL surveys in the literature. The first one is the Meniere's Disease-Patient Oriented Severity Index (MD-POSI), which was generated by Murphy MP and Gates G in 1999. In 2005 Gates G and Verall AM simplified and published the second version of the MD-POSI [6, 11]. The survey assesses the symptoms and functional status of MD patients under four sections. Six items contain questions about the disease and treatment outcomes without any scoring. Two questions examine treatment methods. With this scale, no

Table 6. Dokuz Eylül University Meniere's Disease Disability Scale findings of the Meniere's Disease patients

	Mean Score±SD	Disability as percent (%)
Acute Episode Subscale	33.69±6.96	84.23
Between the Episodes Subscale	58.35±21.47	48.63
Total Score	92.06±24.54	57.54

Table 7. The relations between Dokuz Eylül University Meniere's Disease Disability Scale (MDDS) and Dizziness Handicap Inventory-Turkish version (DHI-T) scores (disability as percentage)

	MDDS					
	Acute Episode Subscale		Between the Episodes Subscale		Total Score	
DHI-T	r	p	r	p	r	p
Physical Subscale	0.220*	0.034	0.263*	0.011	0.292**	0.004
Emotional Subscale	0.239*	0.021	0.478**	0.0001	0.487**	0.0001
Functional Subscale	0.091	0.384	0.331**	0.001	0.315**	0.002
Total Score	0.196	0.06	0.39**	0.0001	0.397**	0.0001

(Spearman's Correlation coefficients; r: correlation coefficients, p: significancy)

**. Correlation is significant at the 0.01 level.

*. Correlation is siginficant at the 0.05 level.

SUBSCALE SCORES:

$$\frac{\text{Sum of subscale scores}}{\text{Maximum possible subscale score}} \times 100 = \text{Disability as percent for each subscale}$$

TOTAL SCORE:

$$\frac{\text{Sum of all scores}}{\text{Maximum possible total score}} \times 100 = \text{Total disability as percent}$$

Figure 1. The percent calculation formulas of sub-scales and total score of DEU-MDDS
DEU-MDDS: Dokuz Eylül University Meniere's Disease Disability Scale

single score can be determined since only the first 16 questions used a Likert scale type, and other questions are open-ended. At the same time, questions related to the otologic symptoms, the emotional effects of MD and self-care activity limitations are not sufficient. This scale has been used in some studies evaluating the outcomes of different treatment modalities in MD patients [27, 28]. The other survey is the Meniere's Disease Outcome Questionnaire (MDOQ), generated by Kato et al. [12] in 2004. This scale was principally developed for patients that had received endolymphatic sac surgery and has also been used to measure outcomes of other treatment methods of MD patients assessing functional, mental and social well-being QoL parameters [26, 29-32]. The MDOQ is restricted to patients in the non-treatment period. Neither the MD-POSI nor the MDOQ has been widely used in the literature. Their structural validities have not been analyzed yet.

In peripheral vestibular disorders, the audiovestibular test battery gives a profusion of information about improvement after treatment. Disabilities are not always visible, however. Laboratory tests do not completely reflect the reality. Chronic diseases that cause symptoms such as vertigo or imbalance affect all areas of life and are perceived differently from patient to patient with age, gender and social status among the contributing factors. Therefore, while evaluating a patient clinically the tools must contain some parameters that explore how daily life is affected by the disease.

In this study, DEU-MDDS was administered to 93 definite MD patients with 52 items (13 items for attack period and 39 items for the non-attack period) initially. As a result of the exploratory and structural factorial analysis, the number of items was reduced to 32. Administration of the final version of the scale does not require a large time investment during clinical practice. The questions are well understood, and all of the items show a significant correlation with each other and the scale. The independence of the scale from the age, gender, and working status of patients and the duration of the disease indicates the applicability of the scale to any MD patients. This feature is a "must-have feature" in this type of questionnaire [5, 33-35]. Demographic features, familial MD history, accompanying other systemic chronic disease history, and bilaterality of the disease findings were similar to those of other studies [36-41]. It has been reported that the emotional stress is the most powerful attack indicator [31, 41-44]. Our finding was the same. Moreover, the audiological, eye movement, and bithermal caloric test findings of the patients were similar to the literature [19, 35, 37-39, 45-52]. Head-shaking nystagmus has been reported as 60% previously, though the value was 20.4% in this study [38].

It has been reported that ear fullness, tinnitus, hyperacusis, falling, and motion limitations could affect QoL in MD patients [53]. In another study, it was reported that "vertigo" was the chief symptom and that "hearing loss" and "tinnitus" affect the patient psychosocially [8]. Studies stating the negative emotional effects of MD and the positive effects of increasing coping strategies are apparent in the literature [54-58].

In a study evaluating 181 MD patients, functional effects of the disease, activity and participation restrictions, and environmental and individual factors were examined. The functional effects include emotional and mental functions, sleeping problems, fear of attack, and feelings of powerlessness, shame, and guilt. Activity restrictions include walking (especially in darkness), use of public transport (short or long distance), and driving (especially at night). Participation restrictions are related to social life, work, personal relationships, sports, hobbies, and other social activities. Environmental factors include use of hearing aids, eating habits, alcohol use, and expectations of relatives. Lifestyle, habits, and personality are affected by individual differences. In this group, the most significant factor was a fear of an unpredictable, threatening, frightening, and/or uncontrollable attack in a work or social environment [59].

Another study in eighty-six definite MD patients reported that symptoms could negatively affect the health-related QoL. Vertigo and imbalance cause anxiety, negatively affecting driving and/or work performance, and psychological well-being. Timing of the attacks is unclear. Vertigo, fullness of ear, hearing loss, living alone, having lower work status, and hopelessness were found to be factors related to decreased QoL [59].

The most popular survey, the DHI, is a reliable tool to assess patients with vestibular disorders, but not appropriate for the episodic structure of MD [8, 10, 28, 34]. Items in the DHI are grouped with three scales. However, it is reported that the scale's scoring system might not be sufficiently sensitive to the minor changes and that Likert scales could be more appropriate [27]. For this reason, in this study, a 1 to 5 Likert scale has been chosen as the scoring system for the DEU-MDDS [17]. In a study, the DHI total scores were 22.67±12.55 points in bilateral MD cases and 17.72±9.98 points in unilateral cases [39]. In another study, the DHI total score was 39±21 points [40]. In the present study, the mean total DHI score in unilateral MD patients was 38.8±19.5 points. The significance of the relationship between DEU-MDDS and DHI-T was also evaluated in this study. The correlation coefficients of the between the episode subscale were higher than those of the acute episode scale of the DEU-MDDS. This result is thought to originate from the limited capacity of the DHI to measure the symptoms in the acute stage. Moreover, the relatively low DHI-T scores could be a result of this condition.

CONCLUSION

As a conclusion, age, gender, degrees of hearing loss nor duration have affected the DEU-MDDS scores. There was a significant relationship between DEU-MDDS and DHI-T. As a part of a clinical follow-up tool for patients with MD, the DEU-MDDS is a valid and reliable health-related, disease-specific QoL scale.

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Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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