The Journal of International Advanced Otology

J Int Adv Otol 2023; 19(4): 323-332 • DOI: 10.5152/iao.2023.21559

Original Article

Associations Among Medical Therapy, Self-Administered Exercise, and Characteristics of Ménière's Disease

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Cite this article as: Pyykkö I, Pyykkö, N, Manchaiah V. Associations among medical therapy, self-administered exercise, and characteristics of Ménière's disease. *J Int Adv Otol.* 2023;19(4):323-332.

BACKGROUND: The aim of the current study was to explore the associations among different therapeutic procedures, self-administered exercise, and characteristics of Ménière's disease.

METHODS: The study used a retrospective design and included 539 people with Ménière's disease who were focusing on self-administered exercise. The mean age and history of Ménière's disease among these participants were 61.9 years and 15.6 years, respectively. Of the participants, 79.5% were female. The data were collected by an electronic questionnaire that focused on symptoms of Ménière's disease, exercise and training habits, balance problems, impacts of the complaints, quality of life, medical treatment, physiotherapy, and psychotherapy.

RESULTS: Of the participants, 79.3% used medical treatment. Betahistine (56.8%) was the most popular followed by periodical anti-emetic use (41.0%) and diuretics (22.4%). Of the participants 70% were doing some self-administered training. The frequency of training depended on age, severity of balance problems, vestibular drop attacks, and gait problems. The type of training depended on age, quality of life, vestibular drop attacks, and gait problems. No association was found between vertigo and frequency/type of balance training.

CONCLUSION: The use or effect of therapeutic procedures for Ménière's disease patients was not related to symptoms experienced. Most participants with Ménière's disease used training programs that aimed to alleviate their condition, especially balance-, gait-, and vestibular drop attack-associated problems. Patient support organizations should be working to help characterize the types of balance disorders people are dealing with in order to individually tailor a rehabilitation program to the patient's needs.

KEYWORDS: Ménière's disease, medical therapy, balance problems, vestibular rehabilitation, postural training, eye movement training

INTRODUCTION

Ménière's disease (MD) is a chronic disorder characterized by low-frequency hearing loss, vertigo attacks, tinnitus, and ear fullness. These symptoms may be noted as the most common ones, as they are defined in the classification of MD.[1] In addition, individuals with MD encounter numerous other problems such as postural instability and mobility problems,[2] vestibular drop attacks (VDA),[3] hyperacusis,[4] nausea, visual problems,[5] and fatigue[6] among others that are not included in the definition of the disease.[7,8]

In a recent study, individuals with MD were asked to rate the impacts of chronic disease on their lives, and they rated balance problems as more severe than even the effects of vertigo and VDA.[9] These "non-classified" complaints often cause activity limitations and participation restrictions.[10,11] For example, due to visually mediated vertigo, patients may have problems while using personal computers, watching TV, driving, or navigating open spaces or corridors.[12-15] These complaints may lead to a disability

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Received: September 21, 2021 • **Accepted:** August 2, 2022 • **Publication Date:** July 31, 2023
Available online at www.advancedotology.org

to work and a reduced quality of life (QoL).[11,16] To alleviate these symptoms of MD, different medical therapy options and therapeutic procedures are recommended, but these have typically focused on vertigo with vague evidence of other complaints associated with MD.[17,18]

The conventional vestibular rehabilitation program focuses on improving balance and postural performance. The overall mechanism of vestibular rehabilitation is to combat dizziness in a controlled manner to promote natural neurological and psychological habituation processes and assist people in coping with the disease.[19-23] Typically, balance training in MD is advocated by healthcare professionals and patient organizations and is undertaken by patients themselves.[23,24] Ménière's disease-specific programs usually include vestibular rehabilitation exercises, which are designed to promote static and dynamic postural stability.[25,26] However, as these programs are designed to promote vestibular habituation after vestibular system function loss, these programs may not be effective in alleviating all other symptoms of MD.[27]

The Finnish Ménière Federation (FMF) conducted a survey to understand the types of medical therapy and self-administered balance exercises being used by the organization's members. The current study used their survey data to examine different therapeutic procedures, self-administered exercises, and their impacts on the characteristics of MD.

MATERIAL AND METHODS

Study Design and Participants

The study used a cross-sectional retrospective design. Permission was obtained from the FMF (Suomen Meniere-liitto) to analyze the registry data they had collected from their members. The data were retrieved through an extensive questionnaire. According to Finnish law, this kind of study using anonymous registry data collected by the patient organization does not require ethical approval. The FMF has 1739 members. Of these, 704 members had no e-mail address listed; therefore, FMF sent its electronic survey to 1035 members. Four e-mail reminders were sent to those who did not respond to initial requests to complete the survey. In total, 539 persons responded (i.e., 52.1% response rate) to the survey. The mean age and duration of the disease were 61.9 years (range 17 to 89 years) and 15.6 years (range 0.5 to 40 years), respectively. The respondents included 423 (79.5%) females and 116 (21.5%) males, representing the gender distribution of the FMF data. To evaluate the effects of medical drug therapy, physiotherapy, and psychotherapy, a follow-up survey was carried out. Out of the 539 members, 365 (67.7%) replied to the follow-up survey. To characterize the diagnosis of MD among FMF members, the diagnostic accuracy of group members (n = 706) was evaluated by experts and compared with criteria of the American Academy of Otolaryngology—Head and Neck Surgery, which suggested that 97% of the members had definite MD and 2.7% had probable MD.[28]

Data Collection

The data were gathered using an electronic questionnaire for assessing the symptoms and consequences of the disorder. The questions focused on the impact, socioeconomic effects, and physical complaints related to MD, specifically balance and postural fitness. The current study was aimed at specifically characterizing postural instability and its impact. The frequency and intensity of the balance problems and their association with visual problems were queried.

In this study, VDA was defined as *a short attack of sudden perturbation of postural stability that was not associated with head movement*. We classified the VDA as *mild* when the patient experienced a sudden feeling of instability associated with tripping, as *moderate* or *balance-related near-fall* when the subjects could search for support with their hands and prevent from falling to the ground. We classified the VDA as *severe* if they fell to the ground.[29] Postural instability was queried, and the severity was rated as *no*, *very mild*, *mild*, *moderate*, *severe*, and *very severe*. The questions also explored vestibular and visual training types, their frequency, and whether the training was guided or self-administered. The impact of the postural complaint was rated on a 4-point scale from *no impact* to *severe impact*. The visual analog scale from the EuroQol EQ-5D-3L questionnaire was used to measure the general health-related QoL.[11]

The medical (or drug) therapy was queried; participants were asked about the types of medications used, as well as the dose and indications. Participants could include information on as many as 10 different medications. Medications used to treat other diseases (e.g., blood pressure, thyroid function compensation, analgesic) were not included in the analysis. The survey included questions regarding types of intratympanic therapy used (i.e., corticosteroids, gentamicin). Additionally, participation in physiotherapy and psychotherapy was recorded.

Data Analysis

Data were analyzed using the IBM Statistical Package for the Social Sciences software version 27.0 (IBM SPSS Corp.; Armonk, NY, USA). Descriptive statistics were explored. Student's *t*-test and analysis of variance with Bonferroni post-hoc tests for multiple comparisons were used when comparing groups with continuous variables. A non-parametric Kruskal–Wallis *H*-test was performed for class and categorical variables along with a Mann–Whitney U-test for multiple comparisons. Logistic stepwise regression was used in modeling the factors for motivating participants for self-training. A *P*-value of .05 was used for the interpretation of statistical significance. Qualitative data from the open-ended questions were analyzed separately using inductive content analysis.

RESULTS

Effect of Medical Therapy on Vertigo and Balance Problems

A total of 365 of the 539 participants who responded to the follow-up of the survey provided information about their medical therapy use. Of these participants, 78 (20.9%) did not use any medications/drugs, although the majority (i.e., 287 or 79.1%) used medical therapies. Betahistines were used either constantly or periodically at varying doses by 207 (56.8%) participants, diuretics were used by 82 (41.0%) participants, anti-emetics (i.e., mostly meclizine or prochlorperazine) were used by 150 (41%) participants, and tranquilizers (i.e., mostly diazepam or clonazepam) was used by 36 (9.8%) participants. Intratympanic steroids (i.e., gentamicin) were given to 16 (4.4%) participants. Physiotherapy and psychotherapy were prescribed to 87 (23.6%) and 16 (4.4%) participants, respectively. In 4 of

Table 1. Effect of Medical Therapy, Physiotherapy, Psychotherapy, and Invasive Treatment on Major Complaints Among Participants with MD. Outcome of Kruskal–Wallis *H*-test and Student's *t*-test are given

Drug	Usage Rate of the Drug (%)	Impact of Vertigo	Impact of Balance	Severity of VDA	QoL
Any drug use	79.3%	$H = 14.7$, $P = .012$**	$H = 17.0$, $P = .004$**	$H = 7.7$, $P = .053$	$t = 0.2$, $P = .846$
Betahistine	56.8%	$H = 6.3$, $P = .28$	$H = 7.7$, $P = .172$	$H = 2.1$, $P = .552$	$t = 2.1$, $P = .033$*
Diuretics	22.4%	$H = 5.8$, $P = .32$	$H = 18.9$, $P = .002$**	$H = 8.6$, $P = .034$*	$t = 1.8$, $P = .061$
Antiemetics	41.0%	$H = 27.3$, $P = .001$***	$H = 10.2$, $P = .069$	$H = 2.2$, $P = .506$	$t = 0.9$, $P = .41$
Tranquilizers	9.8%	$H = 1.3$, $P = 9.39$	$H = 11.9$, $P = .036$*	$H = 4.2$, $P = .240$	$t = 1.8$, $P = .075$
IT-Corticosteroid	4.4%	$H = 3.8$, $P = .57$	$H = 9.795$ $P = .081$	$H = 4.1$, $P = .249$	$t = 1.1$, $P = .285$
IT-Gentamicin	4.4%	$H = 2.4$, $P = .79$	$H = 8.1$, $P = .151$	$H = 1.6$, $P = .658$	$t = 0.15$, $P = .876$
Physiotherapy	23.8%	$H = 7.6$, $P = .17$	$H = 25.4$, $P = .001$***	$H = 15.3$, $P = .002$**	$t = 3.3$, $P = .001$***
Psychotherapy	4.4%	$H = 6.6$, $P = .25$	$H = 22.6$, $P = .001$***	$H = 13.6$, $P = .003$**	$t = 5.1$, $P = .001$***
Surgery	1.4%	$H = 3.1$, $P = .69$	$H = 8.8$, $P = .117$	$H = 11.3$, $P = .010$*	$t = 2.5$, $P = .014$*

MD, Ménière's disease; QoL, health-related quality of life in visual analog scale; VDA, vestibular drop attack.
*$P \leq .05$; **$P \leq .01$; and ***$P \leq .001$.

the participants, endolymphatic sac surgery had been performed. One participant (1.4%) also underwent vestibular nerve sectioning. We observed significant differences in the impact of vertigo, balance problems, VDA, and QoL among the different therapeutic approaches (see Table 1). Betahistine users had better QoL (see Figure 1A); however, in a detailed analysis, it was evident with that usage depended on QoL (see Figure 1B).

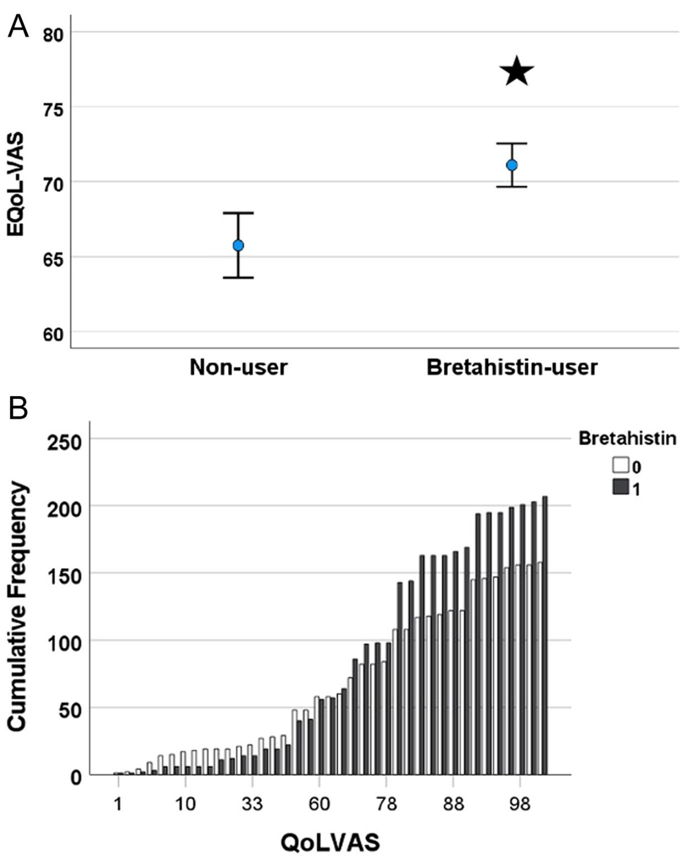

Figure 1. (A) Effect of betahistine on health-related QoL. (B) Cumulative frequency of health-related QoL among users and non-users of betahistine. QoL-VAS, health-related quality of life measured in visual analog scale. Star indicates the statistical difference ($P < .05$) between betahistine users and non-users in Student's *t*-test.

Participants who used physiotherapy and psychotherapy had significantly worse QoL (Figure 2). Interestingly, physiotherapy and psychotherapy were associated with VDA and balance problems, although no impact was observed on vertigo. Those with vertigo used anti-emetics more frequently, whereas those with balance problems used tranquilizers and diuretics more frequently (see Table 1). The impact of VDA was associated with diuretic usage and surgery.

Frequency and Type of Self-Administered Training

Of the 539 participants, 177 (22.9%) did no training (non-trainers). A total of 122 (22.6%) participants trained once a week, 112 (20.6%) participants trained 2-3 times in a week, 117 (21.7%) trained daily, and 11 (2%) participants trained several times per day. The type of exercise was classified into 4 categories, which included (a) *viewing exercises* (viewing near-moving objects with and without moving the head), (b) *guided training* (e.g., yoga, pilates, fitness classes, or supervised balance-focused training), (c) *self-training* (performed most commonly in fitness and training centers), and (d) *walking* (contained "other" outdoor activities such as biking). In *viewing exercises*, subjects followed the instructions provided by the local patient organization (i.e., FMF). Walking was outdoors on paved roads or terrain or even skiing. Often the subjects combined different exercises with *viewing exercises* (see Table 2).

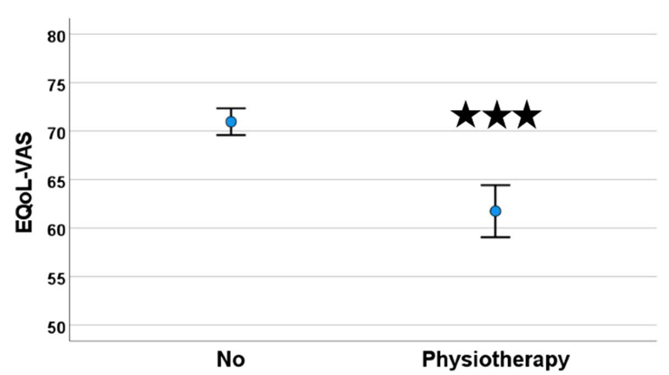

Figure 2. (A) Effect of physiotherapy on health-related QoL. (B) Effect of psychotherapy on health-related QoL. QoL-VAS, health-related quality of life measured in visual analog scale. Stars indicate the statistical difference ($P < .001$) between therapy users and non-users in Kruskal–Wallis *H*-test

Table 2. Frequency of Exercises

Type of Exercises	Frequency	Percent	Cumulative Percent
No training	161	29.9	29.9
Viewing exercises	18	3.3	33.2
Guided training	75	13.9	47.1
Self-training	139	25.8	72.9
Walking	84	15.6	88.5
Guided training and self-training	6	1.1	89.6
Viewing exercises and guided training	11	2.0	91.7
Viewing exercises and walking	2	0.4	92.0
Viewing exercises and self-training	43	8.0	100.0
Total	539	100.0	

For statistical workup, the combined viewing exercises were classified into one and named *viewing plus balance training*. This classification resulted in 5 different training groups, which included (a) no training, (b) viewing exercise, (c) viewing exercise with balance training, (d) guided training, (e) self-training, and (f) walking groups.

Associations Among Type/Frequency Training with Age, Ménière's Disease Duration, and Quality of Life

The frequency of training varied by age of the participants ($F=3.647$, $df=4$, $P=.006$). In pairwise comparison, those who trained daily were on average 4 years older than the other training groups and the non-trainer group ($P=.01$). No difference was observed between duration of MD and frequency of training ($F=0.032$, $P=.538$). Also, no difference was found between QoL and frequency of training ($F=0.639$, $df=4$, $P=.590$). The *type of training* varied by age, as the age of subjects in the different training groups differed from that of the non-trainers ($F=3.267$, $df=4$, $P=.012$). Those who did viewing exercises with balance training ($P=.086$) and walking ($P=.066$) tended to be somewhat older than non-trainers, although these differences were not statistically significant. The duration of MD was not different among the non-trainers and the different types of training groups ($F=1.714$, $df=4$, $P=.146$). However, QoL differed between the training groups ($F=3.742$, $P=.002$). In pairwise comparison, those performing viewing exercises with balance training ($t=2{,}711$, $P=.007$) and those performing walking ($t=2.167$, $P=.031$) had worse QoL when compared with non-trainers (see Figure 3), and in these training groups, QoL was reduced on average by 39% and 36%, respectively.

Association Between Type/Frequency of Training with Severity of Balance Problems

Participants rated the severity of their balance problems into 6 categories. Of the 539 participants, 138 (25.6%) participants had *no* balance problems. *Very mild* balance problems were reported by 91 (16.9%) participants, *mild* by 187 (34.7%), *moderate* by 93 (17.3%), *severe* by 20 (3.7%), and *very severe* by 10 (1.8%) participants.

The QoL of participants varied depending on the severity of balance problems ($F=20.850$, $P < .001$). In participants with no balance problems, QoL was reduced by 24%. Except for the group with very mild balance problems, the QoL of all groups was significantly different when compared to those with no balance problems (see Figure 4). The average QoL in participants with very mild, mild, moderate, severe, and very severe balance problems were reduced by 22%, 31%, 43%, 57%, and 58%, respectively.

The relationships between different training habits and the severity of balance problems were explored. All participants with very severe balance problems (n=10) trained at some level, whereas only 70% (n=20) of participants with severe balance disorders trained. In a Kruskal–Wallis *H*-test (see Figure 5A), the type of balance training varied significantly depending on the severity of balance problems of the participants ($H=19.718$, $P < .001$). Except for the viewing exercises group ($P=.092$), all other training groups differed significantly from the non-training group ($P < .01$). A statistically significant association was noted between the severity of balance problems and the frequency of training ($H=15.849$, $P < .001$). In pairwise comparisons, all groups differed significantly from the non-training group ($P < .01$; see Figure 5B).

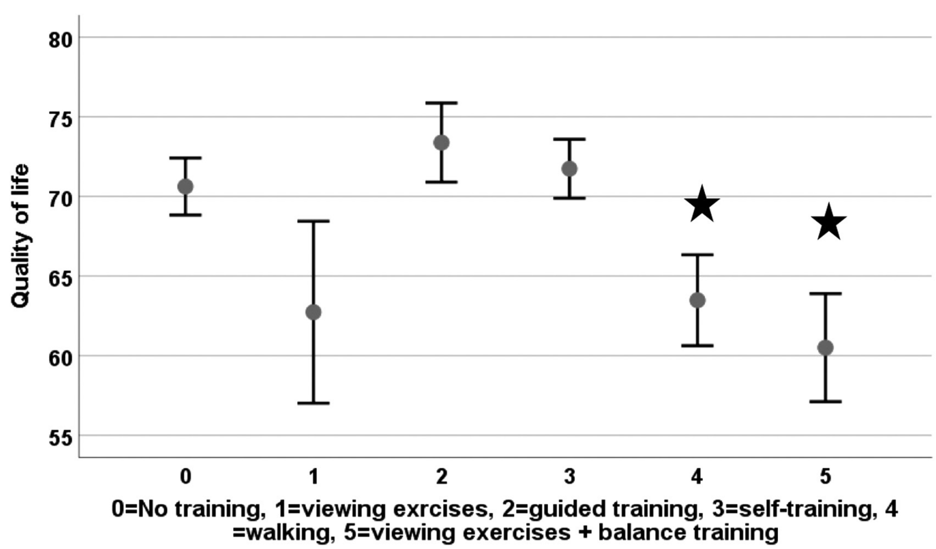

Figure 3. Quality of life for different types of training. Mean and SE are shown. Stars indicate the statistical difference ($P < .05$) between training groups and non-trainers in Student's *t*-test. (0 = no training, 1 = viewing exercises, 2 = guided training, 3 = self-training, 4 = walking, 5 = viewing exercises + balance training). SE, standard error.

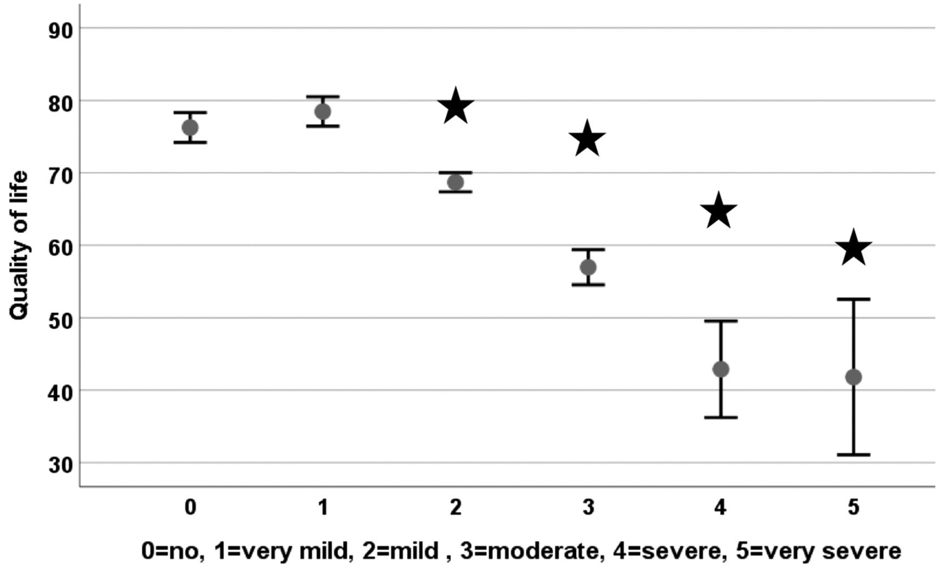

Figure 4. Quality of life for different severity of balance. The impact is rated as no, very mild, mild, moderate, severe, and very severe. Stars indicate the statistical difference ($P < .05$) between no impact and different severity groups in multiple comparison with Bonferroni post-hoc test. Means and SEs are shown. SE, standard error.

Association Between Type/Frequency of Training with Vertigo, Vestibular Drop Attacks, and Gait Problems

When examining the links between type of exercise and vertigo, participants with impacting vertigo attacks tended to perform *viewing plus balance training* more frequently than other training modes, although the difference was not statistically significant ($H=3.270$, $P=.071$). No difference was observed in the frequency of training between non-trainers and trainers with vertigo ($H=0.752$, $P=.386$).

Two hundred eighty-five participants (52.9%) did not have VDA, and 254 had VDA. In 141 (26.2%) participants, VDA was mild with tripping, 56 (10.4%) participants had moderate VDA with near-falls, and 57 (10.5%) participants had severe VDA with falls to the ground. The subjects with impacting VDA more often did *viewing plus balance training* than participants who did not experience VDA ($H=12.870$, $P < .001$) (see Figure 6A). Participants with VDA also trained more frequently than those without VDA ($H=10.066$, $P=.018$). Those who trained daily and weekly differed significantly from the non-training group, but there was no difference between those who trained 2-3 times a week and the non-training group (see Figure 6B). In a detailed analysis, the associations were most prominent in the VDA with tripping ($P=.044$) but not among those participants with VDA who fell to the ground ($P=.231$).

Gait problems were reported among 355 (65.9%) participants. In a Kruskal–Wallis *H*-test, the type of training ($H=17.543$, $P=.004$) and frequency of training ($H=12.256$, $P < .001$) differed significantly from the participants with no gait problems (see Figure 5). In pairwise

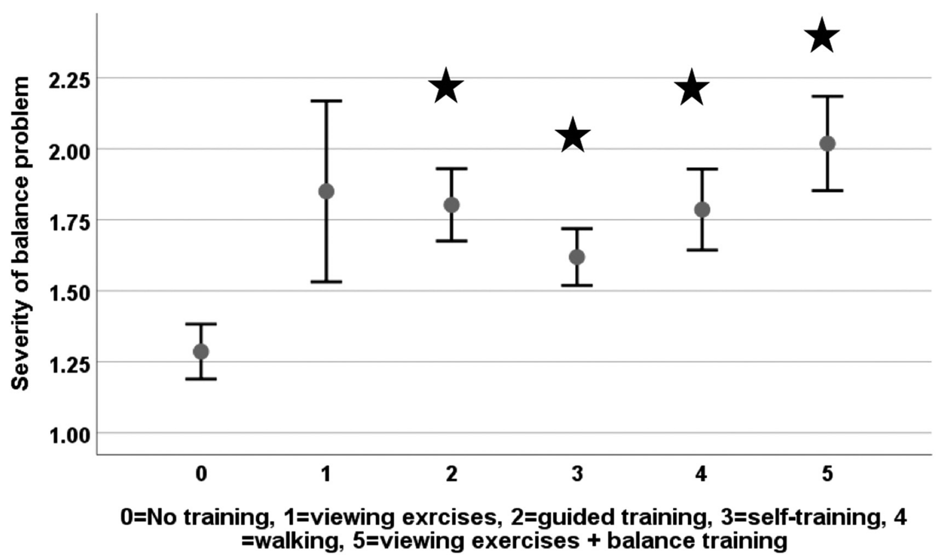

Figure 5. Association between severity of balance problems with type and frequency of training. The impact in ordinate is rated as no, very mild, mild, moderate, severe, and very severe. (A) Different training types: 0 = no training, 1 = viewing exercises, 2 = guided training, 3 = self-training, 4 = walking, 5 = viewing exercises with balance training. (B) Frequency of training: 0 = no training, 1 = weekly training, 2 = 2-3 times in a week training, 3 = daily training. Stars indicate the statistical difference ($P < .05$) between training groups and non-trainers in Mann–Whitney U-test. Means and SEs are shown. SE, standard error.

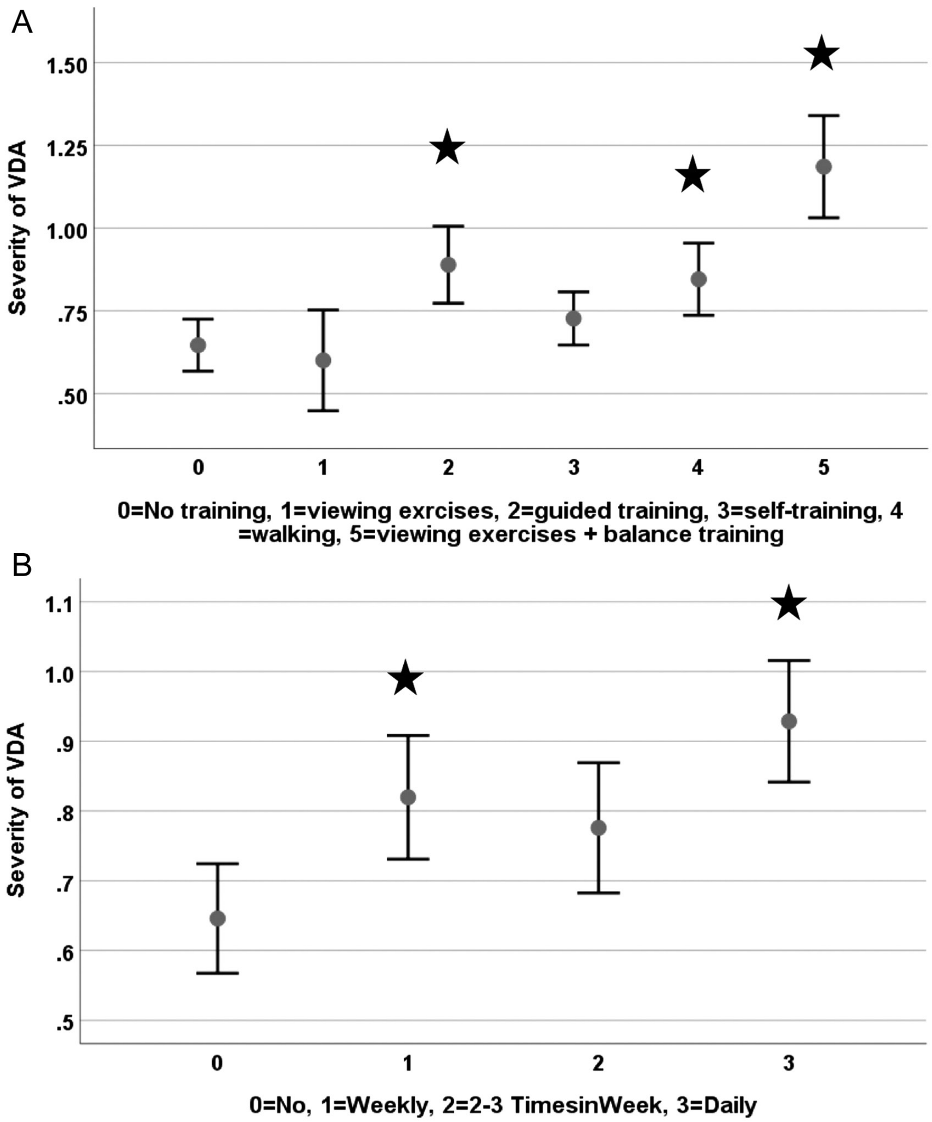

Figure 6. (A) Distribution of different training groups (abscissa) in participants with the severity of VDA (ordinate). The severity of VDA was defined as no VDA = 0, mild = 1, moderate = 2, and severe = 3. (B) Frequency of self-training (abscissa) in participants with VDA (ordinate). Stars indicate the statistical difference ($P < .05$) between training groups and non-trainers in Mann–Whitney U-test. Means and SEs are shown. SE, standard error; VDA, vestibular drop attacks.

comparison, no training groups differed significantly among the groups with different types of training ($P < .01$; Figure 7A). Also, no training groups differed significantly among the groups with different training frequency ($P < .01$; Figure 7B).

Factors Influencing the Self-Perceived Need to Exercise

Using logistic regression analysis, we explored the question of what motivates the participants to exercise. In this model, the participants were divided into 2 groups: exercising and not exercising, which was the dependent factor. The model consisted of 6 predictive factors, which included *postural problems between attacks*, *constant dizziness*, *black spots in the eyes*, *severity of the postural derangement*, and *duration of MD* (see Table 3). All factors were found to be significant predictors in the model ($P < .001$) and could classify the participants into exercise groups correctly by 69.5% (Negelkerke $R^2 = 0.111$).

DISCUSSION

In the present study, we evaluated different medical treatment modes and self-administered exercise strategies among people with chronic MD belonging to a patient organization. The patient organization does not recommend any medical treatment or medication but encourages self-empowerment by recommending self-administered exercises. The goal of self-administered exercises is to improve *visual–vestibular interaction* and to *increase the static* and *dynamic postural stability* of individuals with vestibular problems. In addition, the patient organization aims to promote attitude changes and acceptance of the burden of disease to learn to cope with their MD.[3,23,24,30] The current study showed that participants used different physical exercises as a major strategy to cope with the disorder. The same trend was not observed in medical treatment, with the exception of anti-emetics for vertigo spells, tranquilizers for balance problems, and diuretics for VDA and balance problems. The use of physiotherapy in the present study seems to follow clinical practice guidelines in the United States, which do not recommend physiotherapy for vertigo spells, but physiotherapy is recommended for balance problems.[18] Interestingly, in the current study, participants with VDA used physiotherapy, as it seems to improve coping skills in chronic MD patients.[23]

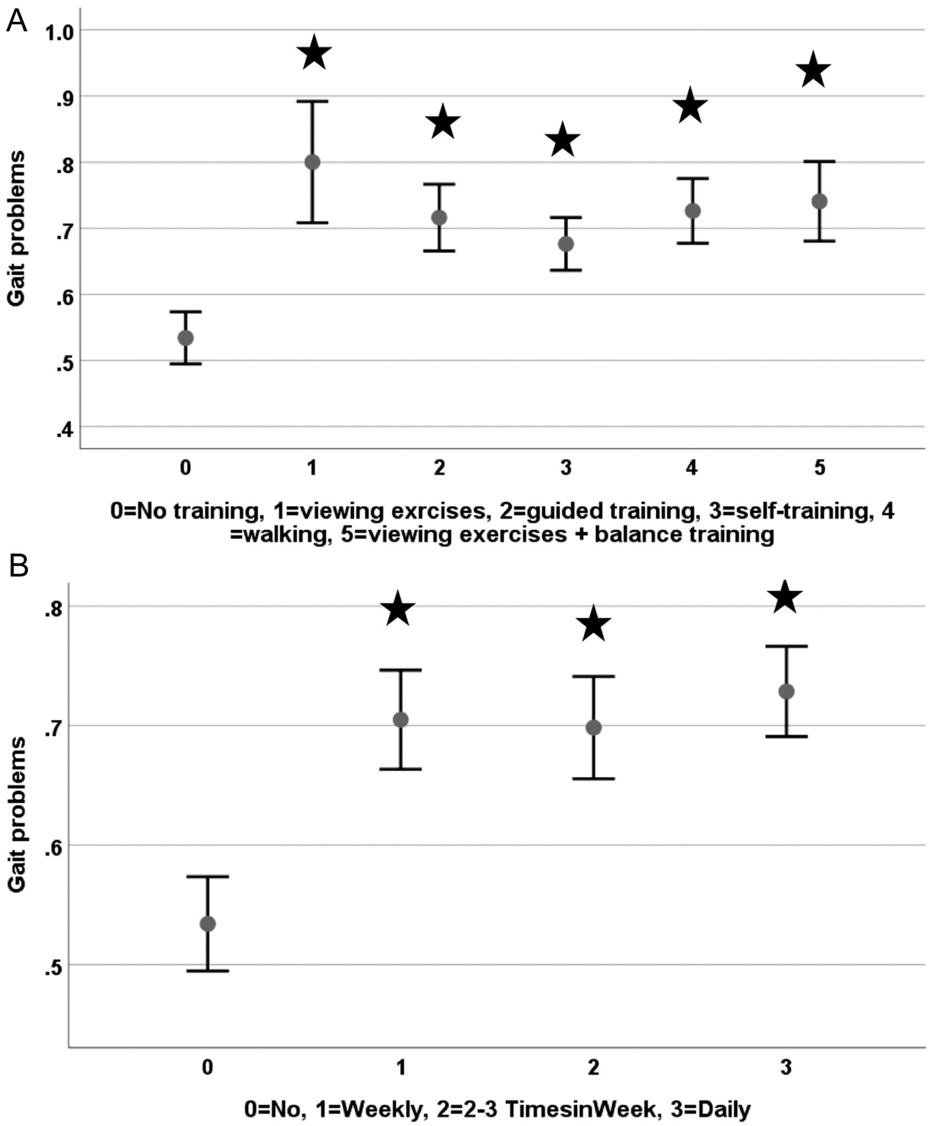

Figure 7. (A) Distribution of different training groups (abscissa) in participants with the occurrence of gait problem (ordinate). (B) Frequency of exercises (abscissa) in participants with the occurrence of gait problem (ordinate). Stars indicate the statistical difference ($P < .05$) between training groups and non-trainers in Mann–Whitney U-test.

The most common type of exercise was non-guided training (26%) followed by walking (16%) and guided training (15%). The viewing exercises combined with other training modes (10%) were present among participants with the poorest QoL and the most problematic balance problems. Of the participants, 30% did not perform any training exercises for various reasons. The most common frequency of training ranged from once a week to daily training and was dependent on the type of exercise. Interestingly, those with severe balance problems trained daily or even several times a day. We did not observe any differences between trainers and non-trainers when

Table 3. Outcome of Logistic Regression Analysis with Variables Explaining Driving for Self-Administered Exercises

	B	SE	Wald	Significance	Exp (B)	95% CI for Exp (B) Lower	95% CI for Exp (B) Upper
Duration of MD	0.189	0.056	11.400	0.001	1.208	1.083	1.348
Black spots in the eyes	0.474	0.228	4.332	0.037	1.607	1.028	2.511
Gait problems	0.501	0.234	4.575	0.032	1.651	1.043	2.613
Constant dizziness	−1.03	0.388	7.085	0.008	0.356	0.166	0.762
Severity of balance problems	0.243	0.097	6.264	0.012	1.275	1.054	1.543
Constant	−0.533	0.259	4.234	0.040	0.587		

MD, Ménière's disease; SE, standard error.

periodic vertigo was considered as a problem, indicating that vertigo was not a reason for self-training. However, participants engaged in a wide spectrum of types of exercise. All these exercises included head and trunk movements to stimulate the vestibular system, but the strength and physical demand of these exercises varied.

Balance Rehabilitation in Ménière's Disease

Healthcare professionals and patient organizations often recommend balance training for individuals with MD.[24,30] The training recommendations are on a wide spectrum, starting from vestibular rehabilitation programs conducted by a physiotherapist to minimally guided Internet-based programs with a focus on self-management. However, adherence to such programs may depend on factors such as disease character, technological savvy, access to a gym, and instructions from the patient organization. For example, older adults with MD often have limited Internet usage skills, and their response to web-based training programs was poor when compared to younger participants, as the FMF experienced it.[30] In the present study, about one-third of the FMF members did not have an e-mail ID and could not respond to the survey. Of those who responded, only 30% did not perform any exercises, and the remaining participants engaged in different types of exercises. In this respect, the current study results confirm those of Kentala et al,[23] who reported that exercise was ranked high as a self-help method in MD and that 50% of users specified either general (35%) or specific exercises (15%) to alleviate their condition. Viewing plus balance exercises were selected especially by those who had problems with balance, visual complaints, and VDA. Those with vertigo were not associated with specific vestibular rehabilitation training, although training may provide better coping with the disease, as indicated by Yardley and Kirby.[24]

There are several items to take into consideration when recommending balance exercises to MD patients, and the programs should be individually tailored. However, in this study, none of the provided exercise programs were individually tailored based on a complaint profile. Several reasons may be behind this. First, the control strategy to keep balance is context-dependent and may vary from active moving younger individuals to home-dwelling elderly individuals.[31] Second, the control strategy will change with age, and different control strategies are used with elderly patients to maintain balance control.[32] Third, the control strategy may be individually selected based on experience. Finally, it may depend on the general health of the patient. Based on these observations, it is evident that it is difficult for patient organizations to provide tailored exercise programs for their members; therefore, patients choose different training strategies and exercise programs based on general guidance. The selected control strategy may work properly in individuals with milder balance problems, but this general guidance may fail in those with severe balance problems.

Vestibular Drop Attacks and Exercise Activity

Vestibular drop attack was defined as sudden imbalance without head movement occurring in even sitting position. In this respect, our definition of VDA covers a wider spectrum of balance problems from mild-to-severe cases leading to falls, and it differs from the original definition of Tumarkin attacks.[9] Thus, the prevalence of VDA in MD was 50% in the present study, and only 10.5% of the participants fell to the ground, as per the original definition. Previously, in modeling the impact of VDA on patients with MD, balance problems were one of the major impacting factors in chronic MD. Vestibular drop attack was one of the main driving forces to exercise in this study. Participants who were tripping used exercises, especially the viewing plus balance training. Interestingly, participants with frequent attacks of VDA tended to train several times a day. To control the impact of VDA and/or postural instability, intratympanic gentamicin or corticosteroids have been recommended, and the outcome of the efficacy in VDA varies between 60% and 100%.[33,34] Gottshall et al[26] and Perez et al[35] advocated vestibular rehabilitation in MD after treatment of VDA. Viewing exercises in connection with balance training could be useful for those with VDA, as the vestibular afferents from the otolith system influence the visual system in so many ways.

Exercise Activity and Quality of Life

van Esch et al[27] suggested inconsistent evidence for the efficacy of current vestibular rehabilitation on balance- and dizziness-related QoL. Interestingly, in the current study, QoL was reduced in viewing plus balance training and in walking groups. Also, training intensity was higher in participants with poorer QoL. These findings can be interpreted as being reported by individuals with MD who have problematic complaints. In the current study, participants tried to improve their functional capacity by making more specific and intensive training. Previously, we have reported that complaints correlated with reduced QoL consisted mostly of balance-related problems, among others.[4,6,11] The current study findings confirmed the association among the severity of balance and gait problems with QoL. Yardley and Kirby[24] suggested that compliance with vestibular rehabilitation increased positive outcomes due to the patient's belief in the effectiveness of the exercise program. The authors suggest that the quantification of effects in future trials should aim to assess individual experiences after exercise and rehabilitation interventions, as those who can adhere to such programs are more likely to find some benefit. This, in part, yielded great variation in outcomes and introduced heterogeneity.

Type of Medication and Training to Address the Patient Needs

The literature on medical therapy for MD seems to focus on the prevention of vestibular spells.[19] Patients who used physiotherapy and psychotherapy seemed to have lower QoL, indicating that they may have had more severe MD and other comorbidities. This observation may also highlight the fact that medical treatment may not fully influence the natural course of MD. The present study also showed that the medical therapy is nonspecific and is not personalized and/or targeted at specific complaints. Both doctors and patients report that they prefer the targeted approach, although it is not typically provided, as reported by the study participants.

Different patient organizations have advocated different types of training programs for individuals with MD, which include guided training programs (e.g., Asahi, Yoga, Nintendo Wii, Tai Chi); web-based self-guided training programs (e.g., program offered by the FMF, YouTube videos); and general non-guided physical training programs (e.g., walking in terrain, fitness clubs).[24,25] In general, the guidance on vestibular rehabilitation provided by patient organizations and/or rehabilitation centers is generic and does not personalize advice based on the type of balance problems the patient is experiencing.[30] For example, a recent literature review was inconclusive for the improvement of QoL following vestibular rehabilitation in patients with MD.[27] We speculate that after acute vestibular function derangement, as after vertigo spells, the body adapts to a low-stiffness strategy of balance control that results in uncoordinated movements between the hip and ankle joints. Poor postural stabilization seems to be associated with a mismatch of vestibulo-spinal responses; accordingly, during recovery, the subjects apply a high-stiffness strategy. Each of these postural strategies has pros and cons and may be alleviated with different types of physiotherapy or vestibular rehabilitation.[36]

Tailoring of therapeutic programs for MD needs further exploration. In association with FMF, we have developed an Internet-based self-help program for MD that focuses on the characterization of the phenotype of MD based on an extensive self-reporting questionnaire and interactively instructs individuals to use coping strategies for MD.[19] In the therapeutic component of the program, the participant defines vision and time frame, inspects confounding factors, determines goals, establishes a strategy, and works on the important problems caused by the disorder.[28,30] A recent pilot study suggested that there was a significant improvement in QoL in MD patients after completing the Internet-based self-help program.[19,30] However, limited etiological data for people with MD hinder the construction of individualized medical therapy. Moreover, there is no consensus on treatment protocols and self-help strategies for MD, and this makes the individualized treatment protocol more complicated.[22] However, an Internet-based self-help program can be helpful to provide rehabilitation for MD patients and supplemental to routine medical therapy.

Study Limitations

The current study has several limitations that should be considered when interpreting the results. First, there is a possible sampling bias, as those responding to the survey have self-selected to participate in the study. Second, the study used a cross-sectional design, which has a major limitation in terms of failing to capture the changes in symptoms as well as medical therapy and rehabilitation needs. However, some participants did comment on the open-ended questions on how their medical therapy changed over time. Third, the complaints reported by participants on self-reported measures were not evaluated objectively using measures such as posturography and various vestibulo-ocular tests. Further studies should validate how reliable the self-reported measures are when compared to objective tests.

In the present study, we evaluated medical therapy and exercise programs carried out by individuals with MD. We evaluated the impact of MD-related complaints and studied the character of balance problems. Individuals who were prescribed physiotherapy and psychotherapy seem to have poor QoL, suggesting they may have a more severe disease. Except for some conditions (e.g., antiemetics in VDA or use of tranquilizers in people with balance problems), medical therapy was nonspecific and not personalized for specific complaints reported. About 70% of participants with MD attempted to adhere to various exercise programs. The most common were physical strength improving self-training programs (27%) followed by walking (16%), guided training programs (15%), eye movement plus balance training (10%), and eye movement exercises (4%). In logistic regression analysis, we found that gait problems, constant dizziness, visual field problems, severity of postural derangement, and duration of MD were the driving forces to perform exercises. Vertigo was not correlated with either frequency or type of balance training. However, frequency of training was associated with age, severity of balance problems, VDA, and gait problems. The type of training was associated with age, QoL, VDA, and gait problems.

Ethics Committee Approval: This study obtained permission from the Finnish Meniere Federation (Date: 8.6.2022), However, no ethical approval was required for this study under the Finnish law.

Informed Consent: N/A.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – I.P., V.M.; Design – I.P., V.M.; Supervision – I.P.; Funding – N/A; Materials – I.P., N.P.; Data Collection and/or Processing – I.P., N.P.; Analysis and/or Interpretation – I.P., V.M.; Literature Review – I.P.; Writing Manuscript – I.P.; Critical Review – N.P., V.M.

Acknowledgments: The authors would like to thank Nina Kallunki at the Finnish Ménière Federation for helping with the recruitment of study participants and all study participants for their time.

Declaration of Interests: The authors declare that they have no conflict of interest.

Funding: The authors declared that this study has received no financial support.

REFERENCES

1. Lopez-Escamez JA, Carey J, Chung WH, et al. Diagnostic criteria for Meniere's disease. *J Vestib Res*. 2015;25(1):1-7. [CrossRef]
2. Pyykkő N, Pyykkő I, Manchaiah V. Postural problems in Meniere's disease; submitted.
3. Pyykkö I, Manchaiah V, Zou J, Levo H, Kentala E. Impact of Tumarkin attacks on complaints and work ability in Ménière's disease. *J Vestib Res*. 2018;28(3-4):319-330. [CrossRef]
4. Levo H, Kentala E, Rasku J, Pyykkő I. Aural fullness in Menière's disease. *Audiol Neurootol*. 2014;19(6):395-399. [CrossRef]
5. Pyykkö I, Manchaiah V, Färkkilä M, Kentala E, Zou J. Association between Ménière's disease and vestibular migraine. *Auris Nasus Larynx*. 2019;46(5):724-733. [CrossRef]
6. Levo H, Kentala E, Rasku J, Pyykkő I. Fatigue in Meniere's disorder. *Hear Balance Commun*. 2013;11(4):191-197. [CrossRef]
7. Gürkov R, Pyykö I, Zou J, Kentala E. What is Menière's disease? – a contemporary re-evaluation of endolymphatic hydrops. *J Neurol*. 2016;263(suppl 1):S71-S81. [CrossRef]
8. Nakashima T, Pyykkö I, Arroll MA, et al. Meniere's disease. *Nat Rev Dis Primers*. 2016;2:16028. [CrossRef]
9. Pyykkö I, Pyykkö N, Manchaiah V. Vestibular drop attacks in Ménière's disease and its association with migraine. *Eur Arch Otorhinolaryngol*. 2020;277(7):1907-1916. [CrossRef]
10. Stephens D, Pyykkő I, Varpa K, Kentala E. Self-reported effects of Menière's disorder on the individual's life: a qualitative analysis. *Otol Neurotol*. 2010;31(2):335-338.
11. Pyykkö I, Manchaiah V, Levo H, Kentala E. Impact evaluation and association with euro QOL 5D health-related utility values in Meniere's disease. *Springerplus*. 2015;4:717. [CrossRef]
12. Levo H, Stephens D, Poe D, Kentala E, Pyykkö I. Use of ICF in assessing the effects of Meniere's disorder on life. *Ann Otol Rhinol Laryngol*. 2010;119(9):583-589. [CrossRef]
13. Huppert D, Straumann D, Magnusson M, Pyykkö I, Brandt T. Dizziness in Europe: from licensed fitness to drive to licence without fitness to drive. *J Neurol*. 2018;265(Suppl 1):9-17. [CrossRef]

14. Pyykkő I, Manchaiah V, Levo H, Kentala E, Juhola M. Internet-based peer support for Ménière's disease: a summary of web-based data collection, impact evaluation, and user evaluation. *Int J Audiol*. 2017;56(7):453-463. [CrossRef]
15. Pyykkö I, Manchaiah V, Zou J, Levo H, Kentala E. Driving habits and risk for traffic accidents among people with Ménière's disease in Finland. *J Int Adv Otol*. 2019;15(2):289-295. [CrossRef]
16. Levo H, Stephens D, Poe D, Kentala E, Rasku J, Pyykkő I. EuroQol 5D quality of life in Menière's disorder can be explained with symptoms and disabilities. *Int J Rehabil Res*. 2012;35(3):197-202. [CrossRef]
17. Clyde JW, Oberman BS, Isildak H. Current management practices in Meniere's disease. *Otol Neurotol*. 2017;38(6):e159-e167. [CrossRef]
18. Basura GJ, Adams ME, Monfared A, et al. Clinical practice guideline: Meniere's disease executive summary. *Otolaryngol Head Neck Surg*. 2020;162(4):415-434. [CrossRef]
19. Appiah-Kubi KO, Wright WG. Vestibular training promotes adaptation of multisensory integration in postural control. *Gait Posture*. 2019;73:215-220. [CrossRef]
20. Herdman SJ. Role of vestibular adaptation in vestibular rehabilitation. *Otolaryngol Head Neck Surg*. 1998;119(1):49 -54. [CrossRef]
21. Horak FB. Postural compensation for vestibular loss and implications for rehabilitation. *Restor Neurol Neurosci*. 2010;28(1):57-68. [CrossRef]
22. Yardley L, Donovan-Hall M, Smith HE, Walsh BM, Mullee M, Bronstein AM. Effectiveness of primary care-based vestibular rehabilitation for chronic dizziness. *Ann Intern Med*. 2004;141(8):598-605. [CrossRef]
23. Kentala E, Levo H, Pyykkő I. How one hundred and eighty three people with Menière's disorder relieve their symptoms: a random cohort questionnaire study. *Clin Otolaryngol*. 2013;38(2):170-174. [CrossRef]
24. Yardley L, Kirby S. Evaluation of booklet-based self-management of symptoms in Ménière disease: a randomized controlled trial. *Psychosom Med*. 2006;68(5):762-769. [CrossRef]
25. Finnish Meniere Federation; 2020. Available at: https://www.suomenmeniereliitto.fi/tukihenkiloille/tyon-tueksi/malli-ohjelmia-meniere-tapahtumi/netti-vertaistuki/.
26. Gottshall KR, Hoffer ME, Moore RJ, Balough BJ. The role of vestibular rehabilitation in the treatment of Meniere's disease. *Otolaryngol Head Neck Surg*. 2005;133(3):326-328. [CrossRef]
27. van Esch BF, van der Scheer-Horst ES, van der Zaag-Loonen HJ, Bruintjes TD, van Benthem PP. The effect of vestibular rehabilitation in patients with Ménière's disease. *Otolaryngol Head Neck Surg*. 2017;156(3):426-434. [CrossRef]
28. Rasku J, Pyykkö I, Levo H, Kentala E, Manchaiah V. Disease profiling for computerized peer support of Ménière's disease. *JMIR Rehabil Assist Technol*. 2015;2(2):e9. [CrossRef]
29. Kutlubaev MA, Xu Y, Manchaiah V, Zou J, Pyykkö I. Vestibular drop attacks in Ménière's disease: a systematic review and meta-analysis of frequency, correlates and consequences. *J Vestib Res*. 2022;32(2):171-182. [CrossRef]
30. Manchaiah V, Pyykkö I, Zou J, Levo H, Kentala E, Juhola M. Patient-reported benefits from patient organization magazines and Internet-based peer support in Ménière's disease. *Patient Prefer Adherence*. 2017;11:1851-1857. [CrossRef]
31. Tuunainen E, Jäntti P, Pyykko I, et al. Intervention to prevent falls in elderly adults living in a residential home. *J Am Geriatr Soc*. 2013;61(8):1426-1427. [CrossRef]
32. Rasku J, Pyykkö I, Juhola M, et al. Evaluation of the postural stability of elderly persons using time domain signal analysis. *J Vestib Res*. 2012;22(5-6):243-252. [CrossRef]
33. Kaasinen S, Pyykkö I, Ishizaki H, Aalto H. Intratympanic gentamicin in Meniere's disease. *Acta Otolaryngol (Stockh.)*. 1998;118(3):294-298. [CrossRef]
34. Viana LM, Bahmad F Jr, Rauch SD. Intratympanic gentamicin as a treatment for drop attacks in patients with Meniere's disease. *Laryngoscope*. 2014;124(9):2151-2154. [CrossRef]
35. PerezN, Santandreu E, Benitez J, Rey-Martinez J. Improvement of postural control in patients with peripheral vestibulopathy. *Eur Arch Otorhinolaryngol*. 2006;263(5):414-420. [CrossRef]
36. Pyykkö N, Pyykkö I, Zou J, Manchaiah V. Does the self-training in Ménière's disease fit the disease characteristics and help alleviate the balance problems?*Int Adv Otol*. 2022;18(1):25-31.