

Research Article



Effect of Vestibular Rehabilitation Therapy on the Daily Life Aspects of Military Men with Persistent Postural-Perceptual Dizziness: A Clinical Trial

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Highlights

- The Persistent Postural-Perceptual Dizziness (PPPD) is a chronic dizziness disorder
- DHI is one of the most widely used questionnaires to measure vestibular dysfunction
- The vestibular rehabilitation therapy is an effective treatment for men with PPPD

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ABSTRACT

Background and Aim: Persistent Postural-Perceptual Dizziness (PPPD) is a type of chronic dizziness without rotation, confusion, or unsteadiness, usually exacerbated by standing, active/passive movements, and complex or moving visual stimuli. Vestibular Rehabilitation Therapy (VRT) is an effective treatment for people with this disease. This study aimed to determine effect of VRT on the daily life aspects of military men with PPPD.

Methods: In this clinical trial, participants were 56 military men with PPPD. They underwent VRT that included exercises for gaze stabilization, adaptation, and habituation. The impact of balance problems caused by PPPD on different physical, emotional, and functional aspects of daily life was evaluated using the Dizziness Handicap Inventory (DHI) before and one month after the intervention.

Results: There was a significant decrease in functional, emotional, physical, and total scores on the DHI after VRT ($p < 0.001$). The DHI scores at baseline showed a moderate handicap (48.64%) which decreased to a mild handicap (24.53%) after VRT. The lowest score at baseline was related to the functional aspect, which showed the highest improvement after VRT.

Conclusion: The VRT can improve all aspects (physical, emotional, and functional) of daily life in military men with PPPD and diminishes the severity of symptoms. Therefore, this treatment can be used as a suitable treatment for these patients.

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Keywords: Persistent postural-perceptual dizziness; dizziness handicap inventory; vestibular rehabilitation; military

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Introduction

Persistent Postural-Perceptual Dizziness (PPPD) is a recent addition to the diagnostic nomenclature [1]. PPPD is a type of chronic dizziness for at least three months without rotation, confusion, or unsteadiness that is usually exacerbated by standing, active/passive movements, and complex or moving visual stimuli [2, 3]. The pathophysiology of this disease is unclear [4]. Recent studies have suggested that PPPD may be caused by functional changes in postural control mechanisms, multisensory processing, or cortical integration in spatial orientation. Therefore, PPPD is classified as a chronic vestibular dysfunction, not a structural disorder [5]. PPPD is a complicated functional neuro-vestibular disorder thought to result from the “mismatch” between “bottom-up” inputs (i.e. vestibular and/or proprioceptive) and inconsistent signals from “top-down” attentional control systems (i.e. anxiety-based hypervigilance) [6]. The prevalence of this disease among patients with vertigo is 11% [7]. PPPD may be misdiagnosed with psychogenic dizziness [8], although approximately three-quarters of people with longstanding PPPD have symptoms of anxiety or depression [9]. The relationship between psychotic disorder and vestibular dysfunction can exist in different forms: 1) organic vestibular dysfunction following anxiety and panic, 2) primary psychotic disorder with a new vestibular symptom, and 3) functional dizziness with secondary depression [10, 11]. Occupational stress is one of the important factors that can affect PPPD and reduce the quality of life [12]. In general, disability, handicap, and psychological disorders are the complications of PPPD [3, 13]. The diagnosis of PPPD is based on history recording, balance tests, and clinical findings. Two methods are used for the treatment of PPPD, including medication therapy (serotonin reuptake inhibitors) and Vestibular Rehabilitation Therapy (VRT) [3]. The goal of VRT is to use a problem-oriented approach to promote compensation. VRT is a non-invasive method useful in treating unilateral and bilateral balance disorders and controlling or reducing symptoms such as nausea and vomiting [14, 15]. This method was designed in the 1990s to treat patients with chronic vestibular dysfunctions. Traditional VRT includes exercises for gaze stabilization, habituation, balance, and gait [16]. Nowadays, the assessment of patients with vestibular dysfunction is not limited to balance tests. It

also includes examining the impact of these disorders on psycho-social functions by using related questionnaires [17]. Therefore, for assessing patients with vestibular dysfunction, it is necessary to carry out quantitative and qualitative examinations separately, and the information obtained from them should be considered in the rehabilitation sessions of each patient [18]. One of the most widely used questionnaires to investigate vestibular dysfunction is the Dizziness Handicap Inventory (DHI) [17].

In 2017, a new definition was given for PPPD. The studies conducted in the field of PPPD are limited. Due to the high occupational stress of military personnel, they may be more susceptible to this disease. This disease can lead to the incapacitation of patients for at least several months and be exacerbated by anxiety and stress [3, 6]. This study aimed to investigate the balance problems (physical, emotional, and functional) caused by PPPD in military men and examine the effect of VRT on reducing these problems.

Methods

Participants

In this clinical trial study, 56 military men with PPPD aged 30–45 years (Mean age=39.03±2.32 years) participated. They were selected from among the military personnel visited military hospitals in Tehran, Iran from June 2022 to February 2023 who had complaints of dizziness. They had the experience of participating in shooting and military exercises. At first, they were examined by a neurologist or an otolaryngologist, and an psychiatrist excluded those with primary psychiatric disorders. After recording the history of participants by a specialist and using initial assessments, those who had a history of dizziness for more than three months, common balance diseases such as benign paroxysmal positional vertigo, Meniere’s disease, and vestibular neuritis was rejected and were referred to the researcher for further investigations. The diagnosis of PPPD was made based on following symptoms proposed by Staab et al. [1]: a) one or more symptoms of dizziness, unsteadiness of dizziness or non-spinning vertigo on most days for at least three months (symptoms that persist for long hours, but may not be present continuously throughout the day due to decrease in severity and symptoms), b) Persistent symptoms that

occur without stimulation, but are exacerbated by three factors: standing, active or passive movement regardless of direction or position, and exposure to moving visual stimuli or complex visual patterns. The disorder is caused by events that cause vertigo, unsteadiness, dizziness, or problems with balance, including acute, episodic or chronic vestibular syndromes, other neurological or medical conditions, and psychiatric disorders, c) symptoms that cause significant distress or functional impairment, d) symptoms that cannot be related to other diseases or disorders [1].

Organic vestibular disorders were excluded by their vague and elusive symptoms and the absence of physical and laboratory findings, as demonstrated by normal bedside vestibular examination, Videonystagmography (VNG), and Vestibular Evoked Myogenic Potentials (VEMP) and Electrocochleography (EcochG). By excluding organic vestibular disorders, participants were diagnosed with PPPD. They were reported to suffer from episodic or persistent nonspecific dizziness, which limited their functional and social activities. They had no history of severe neck or eye injuries, systemic diseases (such as diabetes and high blood pressure), and balance-related disorders such as (Meniere's disease, frequent middle ear infections, and sudden hearing loss). None of them had undergone head surgery, and their Magnetic Resonance Imaging (MRI) results were normal. Those who received vestibular suppressants were also excluded to avoid interference with the habituation mechanisms.

Instrument

The Persian version of the DHI [19] was used to examine the effect of balance problems caused by PPPD on the daily life of patients. This questionnaire contains 25 items and 3 subscales. The items are answered by "yes" (4 points), "sometimes" (2 points) and "no" (zero points). The questions measure the effect of dizziness on physical, emotional, and functional aspects of life [1]. The total score ranges from 0 to 100, and higher scores indicate greater handicap. Based on the total score, the handicap can be classified as mild (0–30), moderate (>30–60), and severe (>60–100) [20].

Procedure

First the complete history of patients was recorded, including the following information: duration of illness,

temporal pattern of dizziness, frequency of vertigo, and aggravating factors. Before the tests, instructions were given to each participant about the study conditions and methods. Written informed consent was obtained from them. Auditory assessments including otoscopic examination, tympanometry, and pure-tone audiometry were then carried out. Next, to examine the balance system, following tests were performed: Bedside vestibular examination, VNG using Ulmer VNG v.1.4 (Synapsys, Inventis, Italy), oculomotor tests, positional/positioning tests, and bithermal caloric tests; ECochG and cVEMP tests using integrity v500 (Vivosonic, Canada).

Vestibular rehabilitation therapy

After completing the Persian version of the DHI [19], participants underwent VRT using a protocol adapted from Gans [21] and Hall and Heusel-Gillig [22]. The VRT program began with an introduction session to inform and teach patients the correct way of performing the exercises. It is an exercise-based program primarily designed to reduce dizziness, gaze instability, imbalance, and risk of falling and to address any secondary impairments caused by vestibular dysfunction. In this research, three sets of exercises of vestibular rehabilitation were applied to patients at home with self-directed or therapist-designed habituation plans included [23]: gaze stabilization exercises, adaptation exercises, and habituation exercises (Table 1). Gaze stabilization exercises were used to reduce vertigo by overcoming gaze instability. Habituation and adaptation exercises were used to improve their performance in difficult situations. The examiner visited the participants once a week for 6 weeks and offered new and more difficult rehabilitation exercises depending on their conditions and the results of previous exercises. Patients were evaluated again using the DHI questionnaire one month after treatment.

Statistical analysis

The collected data were analyzed in SPSS v.17 software, and $p < 0.05$ was considered as statistically significant. Descriptive data analysis was done using mean, standard deviation, and frequency. Normality of data distribution was examined using Kolmogorov-Smirnov test. Due to lack of a normal distribution, Wilcoxon test was used to compare the scores.

Table 1. The protocol of vestibular rehabilitation therapy procedure

Exercise	Instructions	Number of repetitions
Gaze stabilization exercise	Sit facing a blank wall and hold out your thumb straight in front of you. At all times during this exercise keep your eyes fixed on your thumb. Turn your head a little to the right and then to the left. Rhythmically alternate turning ahead from the left to right and back again. The turn from left to right should take approximately one second. Turning your head from left to right should be smooth	15-20 times in a horizontal direction, and 15-20 times in a vertical direction
Adaptation exercise	Walk on a sponge mat with eyes open. Keep your head up with eyes on the target that is at the eye level. Start with small steps and gradually increase the height and speed of steps until it turns into a goose step. Repeat it with eyes closed	First based on the capacity level and then with an increase up to 2 minutes
	Single leg stance on dominant and non-dominant legs	First based on the capacity level and then with an increase time up to 2 minutes
Habituation exercise	Rotate an umbrella side to side in sitting position, keeping the eyes fixed on the rotating patterns while moving the body. Repeat it in standing position	First based on the capacity level and then with an increase up to 4 minutes
	Walking on an indirect path that has obstacles	2–3 days/week. First for 15 minutes and then with an increase by 2 minutes until being able to walk for 30 minutes without symptoms

Table 2. The mean and standard deviation of the tests performed on the participants in the study (n=56)

Test		Mean	SD	
Smooth pursuit (0.2 Hz)	Gain	0.82	0.16	
	Phase	-0.30	0.03	
Saccade (random)	Velocity	415.00 d/s	5.00	
	Latency	160.00 ms	12 ms	
	Accuracy	93%	7%	
Optokinetic (20 d/s)	Gain	0.71	0.20	
	Symmetry	0.07 (left)	-	
Caloric	Fixation index in caloric	73%	12%	
	SPV in caloric	Right	22.00	2.00
		Left	27.00	3.00
cVEMP	Threshold	81.78	2.92	
	Amplitude asymmetry ratio	14.08	3.09	
EcochG (SP/AP)		19.64	4.93	

d/s; degree/second, SPV; slow phase velocity, cVEMP; cervical vestibular evoked myogenic potential, SP/AP; summating potential/action potential

Results

The results of tests (VNG, ECochG and cVEMP) are presented in Table 2. The mean age of patients was 39.03±2.32 years. Table 3 shows the mean scores of DHI and its three components (functional, physical and

emotional) before and after VRT. These results showed that the mean score of DHI and its components were significantly different between pre- and post-VRT phases (p<0.001). Based on the total score of DHI, military men with PPPD had moderate handicap before the VRT (48.64%) and a mild handicap (24.53%) after VRT.

Table 3. Comparing the mean (and standard deviation) of dizziness handicap inventory scores before and after vestibular rehabilitation treatment (Wilcoxon test)

Index	Before VRT			After VRT			p
	Mean(SD)	Maximum	Minimum	Mean(SD)	Maximum	Minimum	
Total DHI	48.64(9.82)	78.00	36.00	24.53(8.29)	58.00	12.00	<0.001
DHI-F	23.10(3.34)	32.00	16.00	10.35(5.16)	26.00	2.00	<0.001
DHI-E	14.46(4.17)	28.00	6.00	7.89(3.70)	20.00	2.00	<0.001
DHI-P	11.25(6.28)	24.00	2.00	6.28(4.73)	16.00	0.00	<0.001

VRT; vestibular rehabilitation treatment, DHI; dizziness handicap inventory, DHI-F; functional dizziness handicap inventory, DHI-E; emotional dizziness handicap inventory, DHI-P; physical dizziness handicap inventory

Discussion

The present study was conducted to evaluate the effect of VRT on military men suffering from PPPD. In this disorder, the patient's motor response pattern changes and most patients manifest significant anxiety [24]. PPPD may be caused by conditions that disrupt balance, such as those that cause dizziness, unsteadiness, or confusion, including peripheral or central vestibular disorders, certain diseases, or psychological disturbances [25]. PPPD can be triggered by an event of acute dizziness or vertigo, which could be not only a transient somatic dysfunction, but also an acute psychological event such as a panic attack [2]. It seems that PPPD affects women more than men, with a high associated prevalence of metabolic disorders and migraine [26]. PPPD is a chronic disease that can last for months or years, and is characterized by: Persistent dizziness or instability not detectable by physical examination, worsening of symptoms when standing, worsening of symptoms with head movements or with complex visual stimuli, presence of illness or emotional shock at symptom onset, concurrent diseases (that exacerbate the symptoms), and anxiety [27, 28]. The mean score of DHI for patients in this study (48.64%) is close to the score reported in a similar study for people suffering PPPD [26]. The results of the present study showed that PPPD affected different aspects of daily life. A study showed that patients with PPPD had a higher burden of dizziness and a lower score in physical domain of life compared to patients with types of other dizziness [29]. In the present study, the PPPD had the highest negative effect on the functional domain, and then on the physical and emotional domains. This can be explained by considering the nature of the disease; PPPD is a chronic disease that persists for a long time,

resulting in a decrease in social activities. The score of functional domain in military men with PPPD before VRT was lower compared to other components. After VRT, this score showed the highest improvement. The functional domain focuses on the patients' ability to perform their jobs, homework, and social activities [30]. PPPD can limit the social activities of military men and thus reduce their functional abilities and consequently their quality of life. We also found improvement in the emotional domain, which is not consistent with the study by Nada who found no improvement in the emotional domain [31]. The handicap, depression, and anxiety experienced by PPPD patients may be the underlying causes. The results of study by Nada et al. are consistent with the results of the present study. They also found improvement in the DHI score (functional, physical and emotional) [31]. In another study Holmberg et al found no significant DHI changes after VRT. This difference may be related to the smaller sample size (n=15) and older age (47 years) of participants in Holmberg et al.'s study [32].

Given that the VRT improved all three aspects of life in military men with PPPD, this treatment can be considered a suitable method to treat these patients. We used exercises for gaze stabilization, adaptation and habituation in the VRT program. In a study, the VRT was found to reduce the severity of PPPD symptoms gradually over time [27]. Some studies have stated that habituation exercises are more appropriate for PPPD than adaptation exercises [23, 31]. Another study found that VRT-induced habituation is a clinically successful treatment strategy for patients with PPPD [31]. We use gaze stabilization exercises because the subjects showed a high sensitivity to moving visual stimuli, and thus required more customized gaze stabilization exercises

[31]. On the other hand, we used adaptation and habituation exercises because some men with PPPD had high sensitivity to the combination of visual, head, and body motions, and were managed with gaze stabilization exercises [31]. Exercises for PPPD should be started with gentle movements and then be increased gradually. Techniques aim at fatiguing abnormal reflexive responses to movement tasks and reducing sensitivity to visual stimuli have shown long-term clinical benefit in PPPD [2].

In our study, only military men with PPPD were evaluated and the effect of gender was not investigated. According to previous studies, the prevalence of this disease seems to be different in term of gender [26]. On the other hand, the effect of medication on the patients was not investigated. It seems that a combination of these therapeutic principles (VRT and medication therapy) as a multimodal interdisciplinary therapy may be beneficial for patients with chronic dizziness [14]. It has been reported that the persistence of dizziness is directly related to the severity of balance impairment and the anxiety caused by bodily sensations during the course [33]. Anxiety affects postural control, motor skills, and eye-tracking test scores. The main triggers of PPPD are visual conflict, head movements, stress, and sleep deprivation [33]. Although VRT was effective in improving the DHI score, there was still mild dizziness in participants 6 weeks after rehabilitation. Providing VRT along with medication therapy for a long period can be effective in men with PPPD. Future randomized controlled trials, prospective studies, use of longer duration for intervention, medication use, and professional supervision are needed to further examine the effectiveness of VRT for PPPD. In our study, before and after rehabilitation exercises, the condition of participants was examined only by the DHI, and no other evaluations were carried out during the exercises which were presented based on the capacities of participants. It is recommended that future studies should use other assessments during the rehabilitation exercises, in addition to DHI, so that new exercises be presented based on more accurate criteria.

Conclusion

The Vestibular Rehabilitation Therapy (VRT) can improve all aspects of daily life in military men with persistent postural-perceptual dizziness and can diminish

the severity of symptoms. Therefore, VRT can be used a suitable treatment for dizziness in these people.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by ethic committee of AJA University of Medical Sciences (Code: IR.AJAUMS.REC.1401.101).

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Authors' contributions

SMRT: Study design, acquisition of data, interpretation of the results, statistical analysis, and drafting the manuscript; FM: Study design, drafting the manuscript, supervising the manuscript; PC: Statistical analysis, drafting the manuscript; SMM: Study design, drafting the manuscript; AN: Study design, drafting the manuscript.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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References

- [1] Staab JP, Eckhardt-Henn A, Horii A, Jacob R, Strupp M, Brandt T, et al. Diagnostic criteria for persistent postural-perceptual dizziness (PPPD): Consensus document of the committee for the Classification of Vestibular Disorders of the Bárány Society. *J Vestib Res.* 2017;27(4):191-208. [DOI:10.3233/VES-170622]
- [2] Popkirov S, Staab JP, Stone J. Persistent postural-perceptual dizziness (PPPD): a common, characteristic and treatable cause of chronic dizziness. *Pract Neurol.* 2018;18(1):5-13. [DOI:10.1136/practneurol-2017-001809]
- [3] Popkirov S, Stone J, Holle-Lee D. Treatment of Persistent Postural-Perceptual Dizziness (PPPD) and Related Disorders.

- Curr Treat Options Neurol. 2018;20(12):50. [DOI:10.1007/s11940-018-0535-0]
- [4] Li L, He S, Liu H, Pan M, Dai F. Potential risk factors of persistent postural-perceptual dizziness: a pilot study. *J Neurol.* 2022;269(6):3075-85. [DOI:10.1007/s00415-021-10899-7]
- [5] Zachou A, Anagnostou E. Diagnostic value of key signs in persistent postural-perceptual dizziness. *J Neurol.* 2020;267(6):1846-8. [DOI:10.1007/s00415-020-09820-5]
- [6] Seemungal BM, Passamonti L. Persistent postural-perceptual dizziness: a useful new syndrome. *J Psychosom Res.* 2018;76:80-3.
- [7] Siriwardhana R, Somarathna M, Sooriyaarachchi M, Subasinghe S, Sumanasekara H, Hapuarachchi C, et al. Prevalence of Paternal Postpartum Depression in Anuradhapura District in Sri Lanka and Its Association With Maternal Postpartum Depression as a Risk Factor. *Journal of Family and Reproductive Health.* 2022;13:239-42.
- [8] Dieterich M, Staab JP, Brandt T. Functional (psychogenic) dizziness. *Handb Clin Neurol.* 2016;139:447-68. [DOI:10.1016/B978-0-12-801772-2.00037-0]
- [9] Staab JP, Ruckenstein MJ, Solomon D, Shepard NT. Serotonin reuptake inhibitors for dizziness with psychiatric symptoms. *Arch Otolaryngol Head Neck Surg.* 2002;128(5):554-60. [DOI:10.1001/archotol.128.5.554]
- [10] Honaker JA, Gilbert JM, Staab JP. Chronic subjective dizziness versus conversion disorder: discussion of clinical findings and rehabilitation. *Am J Audiol.* 2010;19(1):3-8. [DOI:10.1044/1059-0889(2009/09-0013)]
- [11] Simon NM, Pollack MH, Tuby KS, Stern TA. Dizziness and panic disorder: a review of the association between vestibular dysfunction and anxiety. *Ann Clin Psychiatry.* 1998;10(2):75-80. [DOI:10.1023/a:1026167000066]
- [12] Teh CS, Prepageran N. The impact of disease duration in persistent postural-perceptual dizziness (PPPD) on the quality of life, dizziness handicap and mental health. *J Vestib Res.* 2022;32(4):373-80. [DOI:10.3233/VES-210087]
- [13] Spielberger CD, Reheiser EC. Job stress in university, corporate, and military personnel. *Int J Stress Manage.* 1994;1(1):19-31. [DOI:10.1007/BF01857281]
- [14] Patatas OH, Ganança CF, Ganança FF. Quality of life of individuals submitted to vestibular rehabilitation. *Braz J Otorhinolaryngol.* 2009;75(3):387-94. [DOI:10.1016/S1808-8694(15)30657-1]
- [15] Aratani MC, Ricci NA, Caovilla HH, Ganança FF. Brazilian version of the Vestibular Disorders Activities of Daily Living Scale (VADL). *Braz J Otorhinolaryngol.* 2013;79(2):203-11. [DOI:10.5935/1808-8694.20130036]
- [16] Cawthorne T. The physiological basis for head exercises. *The Journal of the Chartered Society of Physiotherapy.* 1944;30:106.
- [17] Waller B, Munukka M, Rantalainen T, Lammentausta E, Nieminen MT, Kiviranta I, et al. Effects of high intensity resistance aquatic training on body composition and walking speed in women with mild knee osteoarthritis: a 4-month RCT with 12-month follow-up. *Osteoarthritis Cartilage.* 2017;25(8):1238-46. [DOI:10.1016/j.joca.2017.02.800]
- [18] Wainner RS, Fritz JM, Irrgang JJ, Boninger ML, Delitto A, Allison S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. *Spine (Phila Pa 1976).* 2003;28(1):52-62. [DOI:10.1097/00007632-200301010-00014]
- [19] Jafarzadeh S, Bahrami E, Pourbakht A, Jalaie S, Daneshi A. Validity and reliability of the Persian version of the dizziness handicap inventory. *J Res Med Sci.* 2014 Aug;19(8):769-75.
- [20] Whitney SL, Wrisley DM, Brown KE, Furman JM. Is perception of handicap related to functional performance in persons with vestibular dysfunction? *Otol Neurotol.* 2004;25(2):139-43. [DOI:10.1097/00129492-200403000-00010]
- [21] Gans RE. Vestibular rehabilitation: protocols and programs. San Diego: Singular Pub. Group; 1996. viii, 120.
- [22] Hall CD, Gillig-Heusel L. Physical Therapy and Management of People with Non-Vestibular Dizziness. *Vestibular Rehabilitation.* In: Herdman SJ, Clendaniel RA, editors. Philadelphia, PA: F.A. Davis Company; 2014. p. 569-83.
- [23] Staab JP. Behavioral aspects of vestibular rehabilitation. *NeuroRehabilitation.* 2011;29(2):179-83. [DOI:10.3233/NRE-2011-0693]
- [24] Piker EG, Jacobson GP. Self-report symptoms differ between younger and older dizzy patients. *Otol Neurotol.* 2014;35(5):873-9. [DOI:10.1097/MAO.0000000000000391]
- [25] Staab JP. Persistent Postural-Perceptual Dizziness. *Semin Neurol.* 2020;40(1):130-7. [DOI:10.1055/s-0039-3402736]
- [26] Bittar RS, Lins EM. Clinical characteristics of patients with persistent postural-perceptual dizziness. *Braz J Otorhinolaryngol.* 2015;81(3):276-82. [DOI:10.1016/j.bjorl.2014.08.012]
- [27] Huppert D, Strupp M, Rettinger N, Hecht J, Brandt T. Phobic postural vertigo--a long-term follow-up (5 to 15 years) of 106 patients. *J Neurol.* 2005;252(5):564-9. [DOI:10.1007/s00415-005-0699-x]
- [28] Kapfhammer HP, Mayer C, Hock U, Huppert D, Dieterich M, Brandt T. Course of illness in phobic postural vertigo. *Acta Neurol Scand.* 1997;95(1):23-8. [DOI:10.1111/j.1600-0404.1997.tb00063.x]
- [29] Steensnaes MH, Knapstad MK, Goplen FK, Berge JE. Persistent Postural-Perceptual Dizziness (PPPD) and quality of life: a cross-sectional study. *Eur Arch Otorhinolaryngol.* 2023. [DOI:10.1007/s00405-023-08040-7]
- [30] Van De Wyngaerde KM, Lee MK, Jacobson GP, Pasupathy K, Romero-Brufau S, McCaslin DL. The Component Structure of the Dizziness Handicap Inventory (DHI): A Reappraisal.

- Otol Neurotol. 2019;40(9):1217-23. [DOI:10.1097/MAO.0000000000002365]
- [31] Nada EH, Ibraheem OA, Hassaan MR. Vestibular Rehabilitation Therapy Outcomes in Patients With Persistent Postural-Perceptual Dizziness. *Ann Otol Rhinol Laryngol*. 2019;128(4):323-9. [DOI:10.1177/0003489418823017]
- [32] Holmberg J, Karlberg M, Harlacher U, Rivano-Fischer M, Magnusson M. Treatment of phobic postural vertigo. A controlled study of cognitive-behavioral therapy and self-controlled desensitization. *J Neurol*. 2006;253(4):500-6. [DOI:10.1007/s00415-005-0050-6]
- [33] Heinrichs N, Edler C, Eskens S, Mielczarek MM, Moschner C. Predicting continued dizziness after an acute peripheral vestibular disorder. *Psychosom Med*. 2007;69(7):700-7. [DOI:10.1097/PSY.0b013e318151a4dd]