OPEN

A Validated Questionnaire to Assess the Severity of Persistent Postural-Perceptual Dizziness (PPPD): The Niigata PPPD Questionnaire (NPQ)

Chihiro Yagi, Yuka Morita, Meiko Kitazawa, Yoriko Nonomura, Tatsuya Yamagishi, Shinsuke Ohshima, Shuji Izumi, Kuniyuki Takahashi, and Arata Horii

Department of Otolaryngology, Head and Neck Surgery, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

Objective: To establish a questionnaire to diagnose and assess the severity of persistent postural-perceptual dizziness (PPPD).
Study Design: Retrospective chart review.
Setting: Tertiary referral center.
Patients: Fifty PPPD patients and 50 consecutive control patients with other vestibular disorders.
Interventions: Patients answered questions on three exacerbating factors of PPPD (upright posture/walking, movement, and visual stimulation), and each factor was evaluated using four questions scoring the severity from 0 (none) to 6 (unbearable). Somatic and psychological distress was evaluated by the Visual Analog Scale (VAS) and the Hospital Anxiety and Depression Scale (HADS), respectively.
Main Outcome Measures: The questionnaire's reliability was tested by Cronbach's alpha, and it was validated by examining the differences in the questionnaire's scores between PPPD patients and controls. The area under the curve (AUC) of the receiver operating characteristic curve for each factor was calculated.
Results: Cronbach's alpha coefficient was >0.8 for all factors, except the movement factor. There were no significant differences in the VAS and HADS scores between the two groups. However, the combined and individual questionnaire scores for each factor were higher in PPPD patients than in controls, indicating the questionnaire's high validity. The AUC was widest for the visual stimulation factor (0.830), and a score of 9 (full score 24) had the best sensitivity (82%) and specificity (74%) for discriminating PPPD patients from controls.
Conclusions: We developed a questionnaire that exhibited high reliability and validity in evaluating PPPD severity. The visual stimulation factor may be the most characteristic among the three exacerbating factors. **Key Words:** Cronbach's alpha—Persistent postural-perceptual dizziness—Receiver operating characteristic curve—Reliability—Validity.

Otol Neurotol **40:**e747–e752, 2019.

Persistent postural-perceptual dizziness (PPPD) is characterized by persistent chronic vestibular syndrome lasting >3 months that is typically preceded by acute vestibular disorders (1). The core vestibular symptoms of PPPD are dizziness, unsteadiness, or nonspinning vertigo and are exacerbated by upright posture/walking, active or passive movement, and exposure to moving or complex visual stimuli (1). PPPD is classified as a functional disorder but is not a structural or psychiatric condition (1). In particular, the presence of three exacerbating factors is a characteristic of PPPD. No specific laboratory test for PPPD is available, and the precise assessment of symptoms, exacerbating factors, and medical history is important for PPPD diagnosis (1). To date, no questionnaires have been developed to aid the diagnosis or

Address correspondence and reprint requests to Chihiro Yagi, M.D., Department of Otolaryngology, Head and Neck Surgery, Niigata University Graduate School of Medical and Dental Sciences, Asahimachi 1, Niigata city, Niigata 951-8510, Japan; E-mail: sorasora.yoky@gmail.com

This work was supported by Grants-in-Aid from the Ministry of Education, Culture, Sports, Science and Technology of Japan to C.Y. and A.H.

This study was presented at the 54th Annual Spring Meeting for American Neurotology Society held at Austin, Texas (May 3–4, 2019).

The authors disclose no conflicts of interest.

DOI: 10.1097/MAO.0000000000002325

assessment of PPPD severity. In the present study, we developed a 12-item questionnaire evaluating the three exacerbating factors of PPPD and tested its reliability and validity to diagnose PPPD.

METHODS

Patients

This study was approved by the IRB of Niigata University Medical and Dental Hospital (#2017-0382). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Fifty PPPD patients who met the diagnostic criteria proposed by the Bárány Society (1) and 50 consecutive patients with other vestibular disorders who visited the Department of Otolaryngology Head and Neck Surgery at Niigata University Medical and Dental Hospital between January and May 2018 were enrolled in the study. The PPPD group included 12 men and 38 women, and the control group included 19 men and 31 women. There were no sex differences between groups (Fisher's exact test, $p = 0.194$). The PPPD group mean age (49.5 yr, range 25–79 yr) was significantly younger than that of the control group (57.3 yr, range 20–82 yr) (t test, $p < 0.05$). The precipitating conditions for the PPPD patients are provided in Table 1, and the diseases of the patients in the control group in Table 2. Due to the retrospective nature of the study, the status of treatment (e.g., before or during treatment and with or without medication) was not consistent among the patients.

The Niigata PPPD Questionnaire

The English translation of the Niigata PPPD Questionnaire (NPQ) is presented in Table 3. The NPQ evaluates the degree of symptom exacerbation by the three characteristic factors: upright posture/walking, movement, and visual stimulation. Each factor was assessed by four questions; thus, there were 12 questions in the questionnaire. Q3, 6, 7, and 11 pertained to upright posture/walking; Q1, 5, 9, and 12 pertained to movement; and Q2, 4, 8, and 10 pertained to visual stimulation. Each question was scored from 0 (none) to 6 (unbearable); therefore, the total score for each factor was 24, and the total score for all three factors was 72. Somatic distress due to PPPD was evaluated by the 100 mm Visual Analog Scale (VAS). Psychological distress was evaluated by the Hospital Anxiety and Depression Scale (HADS) (2), which consists of anxiety and depression subscales. Each HADS subscale was assessed by seven questions. Each question was scored from 0 (not at all) to 3 (most of the time, very often); therefore, the total score for each HADS subscale was 21, and the total HADS score was 42.

Statistics

The reliability of the questionnaire was tested by Cronbach's alpha (3). The questionnaire was validated by examining the differences in the total NPQ score, score for each factor, VAS score, and HADS score between the PPPD and control groups using the Mann–Whitney U test. To compare the diagnostic capability of the factors, a receiver operating characteristic (ROC) curve was constructed and the area under the curve (AUC) for each factor was calculated. All statistical analyses were performed using SPSS version 21.0 for Windows. The significance level was set at $p < 0.05$.

TABLE 1. *Precipitating conditions for PPPD patients*

	Patients (n)
Peripheral vestibular dysfunction	19
BPPV	9
Menière's disease	6
No specific precipitants	5
Panic attack	3
Phobia	2
Orthostatic dysfunction	2
Delayed endolymphatic hydrops	1
Vestibular neuritis	1
Sudden deafness with vertigo	1
Cerebellar infarction	1

BPPV indicates benign paroxysmal positional vertigo.

TABLE 2. *Diseases in the control group*

	Patients (n)
Menière's disease	15
Peripheral vestibular dysfunction	11
Undifferentiated dizziness	7
Psychogenic dizziness	5
BPPV	3
Delayed endolymphatic hydrops	2
Vestibular migraine	2
Panic disorder	2
Vestibular neuritis	1
Sudden deafness with vertigo	1
Myelopathy	1

BPPV indicates benign paroxysmal positional vertigo.

TABLE 3. *Niigata Persistent Postural-Perceptual Dizziness Questionnaire*

Instructions: The purpose of this questionnaire is to identify the difficulties in daily life activities that you may be experiencing due to dizziness. Please indicate your answer by circling the number that best describes the extent to which you have been affected during the past week. If you completely avoid performing any of these actions, circle the number 6.

	None Unbearable
Q1. Quick movements such as standing up or turning your head	0 1 2 3 4 5 6
Q2. Looking at large store displays	0 1 2 3 4 5 6
Q3. Walking at a natural pace	0 1 2 3 4 5 6
Q4. Watching TV or movies with intense movement	0 1 2 3 4 5 6
Q5. Riding a car, bus, or train	0 1 2 3 4 5 6
Q6. Sitting upright in a seat without back and arm support	0 1 2 3 4 5 6
Q7. Standing without touching fixed objects	0 1 2 3 4 5 6
Q8. Watching a scroll screen on a PC or smartphone	0 1 2 3 4 5 6
Q9. Performing activities such as housework or light exercise	0 1 2 3 4 5 6
Q10. Reading small letters in a book or newspaper	0 1 2 3 4 5 6
Q11. Striding at a rapid pace	0 1 2 3 4 5 6
Q12. Riding an elevator or escalator	0 1 2 3 4 5 6

TABLE 4. *Cronbach's alpha coefficients for the Niigata Persistent Postural-Perceptual Dizziness Questionnaire total score and scores for each factor*

Total Score	0.91[a]
Upright posture/walking score	0.88[a]
Movement score	0.75
Visual stimulation score	0.83[a]

[a]>0.8 High reliability.

RESULTS

As indicated in Table 4, the Cronbach's alpha coefficients for the total score and the scores for each factor were >0.8, with the exception of that for movement (0.75).

Figure 1 illustrates the differences in NPQ scores between the PPPD group and the control group. The total score (Fig. 1A) and the scores for each factor (upright posture/walking, movement, and visual stimulation) were significantly higher in the PPPD group than in the control group. The largest difference between the two groups was for visual stimulation (Fig. 1B).

Figure 2 presents the VAS (Fig. 2A) and HADS (Fig. 2B) scores for the PPPD and control groups. There were no significant differences in the VAS and HADS scores—total HADS scores as well as anxiety and depressive subscale scores—between the two groups.

Figure 3 presents the ROC curves for the total score and the scores for each NPQ factor. The AUC of the ROC curve and the cut-off point to identify the best sensitivity and specificity for diagnosing PPPD for each factor are also presented. The AUC for the total score was 0.780 and scores of 27 and 29 (full score: $6 \times 12 = 72$) had the best sensitivity (score of 27: 70%; score of 29: 68%) and specificity (score of 27: 68%; score of 29: 70%) for diagnosing PPPD. The AUC was widest for the visual stimulation factor (0.830) and a score of 9 (full score: $6 \times 4 = 24$) had the best sensitivity (82%) and specificity (74%) for discriminating PPPD patients from controls. The AUC was narrowest for upright posture/walking (0.684).

DISCUSSION

PPPD is classified as a functional disorder but is not a structural or psychiatric condition (1). According to recent imaging studies, functional changes in postural control mechanisms, multisensory information processing, or cortical integration of spatial orientation and threat assessment were postulated as pathophysiological mechanisms of PPPD (1,4–8). Indeed, the diagnostic criteria for PPPD (1) do not include laboratory test thresholds (e.g., vestibulo-ocular reflex gain) that are included in the diagnostic criteria of bilateral vestibulopathy (9). The diagnosis of PPPD requires a precise assessment of vestibular symptoms, exacerbating factors, and medical history. A validated questionnaire would be

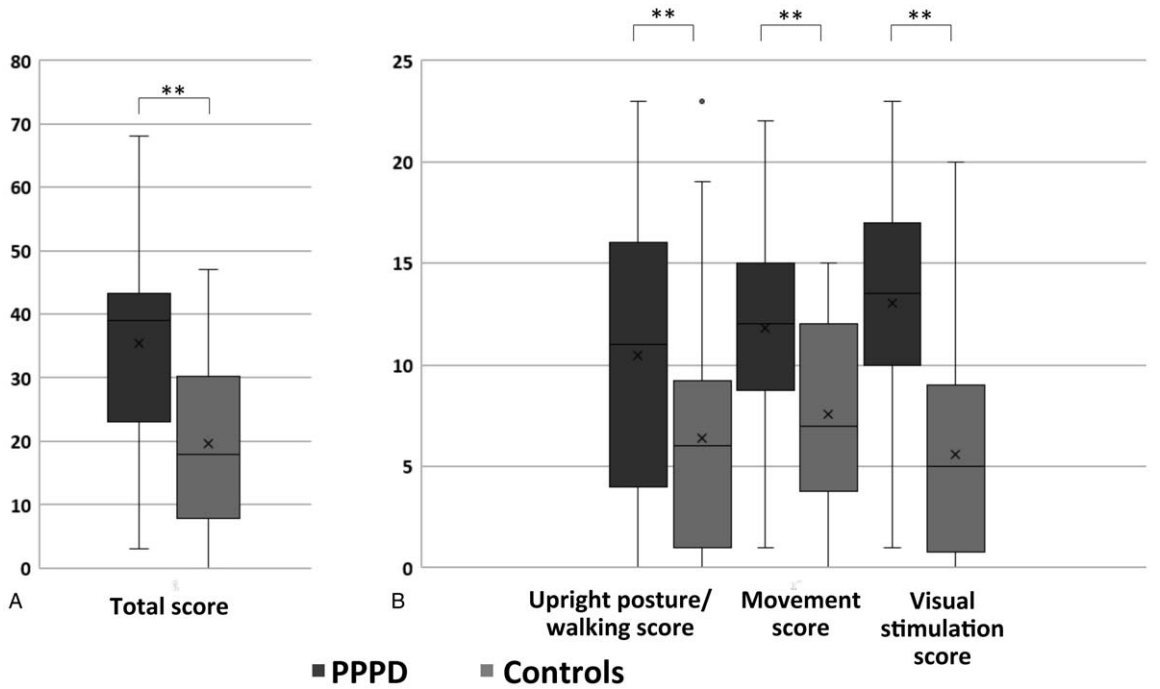


FIG. 1. Niigata Persistent Postural-Perceptual Dizziness Questionnaire scores in the persistent postural-perceptual dizziness and control groups. The total score (*A*) and the scores for each factor (*B*) were significantly higher in the persistent postural-perceptual dizziness (PPPD) group than in the control group. The differences between the groups were most apparent in visual stimulation (*B*). Persistent postural-perceptual dizziness (PPPD); $^{**}p < 0.01$.

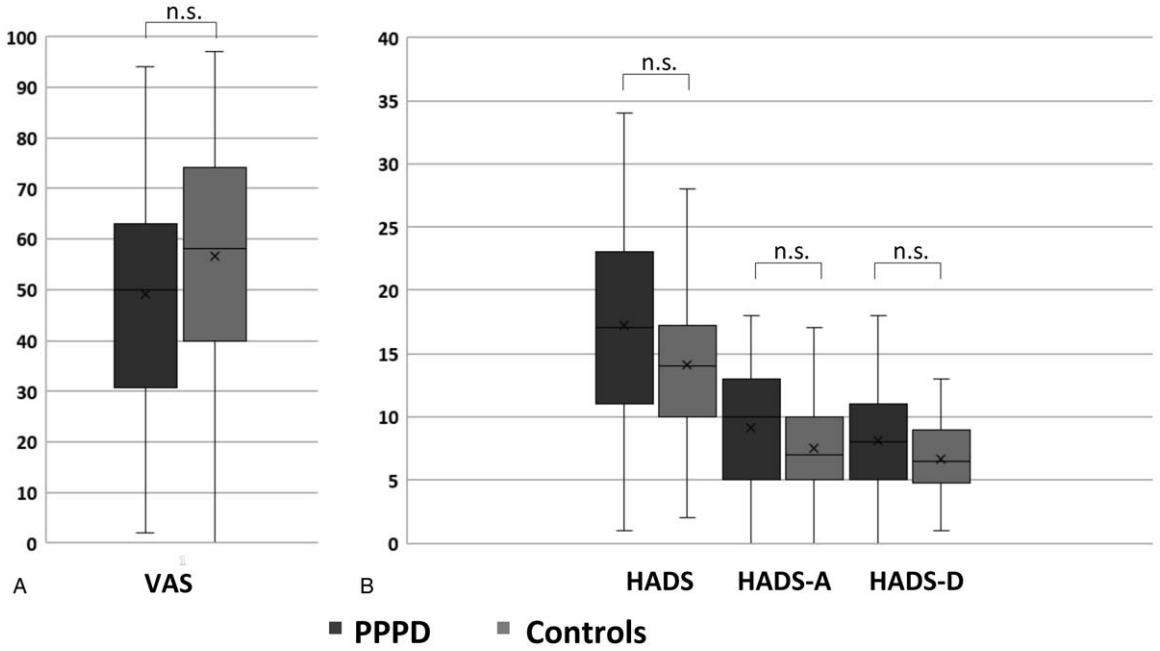
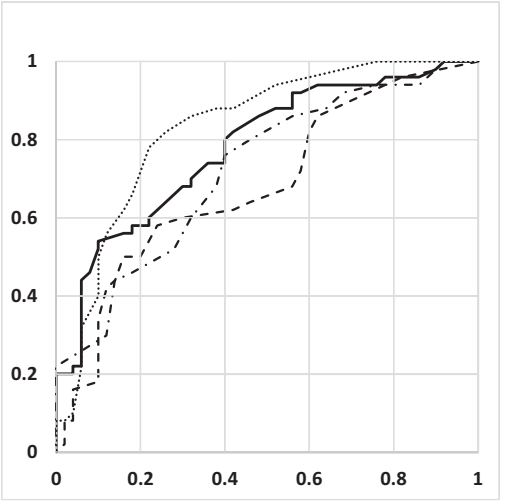


FIG. 2. Visual Analog Scale and Hospital Anxiety and Depression Scale scores in the persistent postural-perceptual dizziness and control groups. There were no significant differences in the visual analog scale (VAS) (*A*) and Hospital Anxiety and Depression Scale (HADS) scores (*B*) (total as well as anxiety [A] and depression [D] factor scores) between the two groups. Persistent postural-perceptual dizziness (PPPD); n.s. indicates not significant.



		AUC	Cut-off point	Sensitivity	Specificity
———	Total score	0.780	27	0.70	0.68
			29	0.68	0.70
– – – –	Upright posture/walking	0.684	9	0.60	0.70
– · – · –	Movement	0.723	9	0.76	0.60
·····	Visual stimulation	0.830	9	0.82	0.74

FIG. 3. Receiver operating characteristic curves for the total score and scores for each of the Niigata Persistent Postural-Perceptual Dizziness Questionnaire factor. The area under the curve (AUC) was widest for the visual stimulation factor (0.830) and a score of 9 (full score = 24) had the best sensitivity (82%) and specificity (74%) for discriminating persistent postural-perceptual dizziness (PPPD) patients from controls. The AUC was narrowest for the upright posture/walking factor (0.684).

highly beneficial for the full and efficient evaluation of these points. Therefore, we developed a questionnaire for diagnosing and assessing PPPD severity.

Cronbach's alpha is widely used for the assessment of questionnaire reliability (3). The coefficient ranges from 0 to 1 and values of >0.8 typically indicate high reliability in terms of internal consistency (3). As indicated in Table 3, the Cronbach's alpha coefficients of the total NPQ score and the score for each NPQ factor were high (0.83–0.91), with the exception of that for the movement factor (0.75). This indicates that most NPQ factors (aside from movement) were highly reliable with high internal consistency. Regarding the slightly lower value for movement, this factor was measured using questions that could be divided into two categories: active-movement-induced and passive-movement-induced symptoms. In a clinical setting, one patient is highly susceptible to active movements, whereas the vestibular symptoms of another patient decrease with exposure to passive movements. Such inconsistency among movement questions would result in a low Cronbach's alpha coefficient for the movement factor (0.75) relative to those for other factors (>0.83).

To validate the questionnaire, the total NPQ score and the scores for each NPQ factor were compared between the PPPD group and the control group. The total score of the NPQ and the scores for each exacerbating factor of the NPQ were significantly higher in the PPPD group than in the control group (Fig. 1). In contrast, the VAS score did not differ between the PPPD and control groups (Fig. 2A). Thus, the differences in the NPQ scores between the PPPD and control groups were not due to differences in subjective severity as measured by VAS. Rather, the higher NPQ scores in the PPPD group relative to the control group suggest that this questionnaire effectively captured key PPPD characteristics and was useful for discriminating PPPD patients from control patients and for assessing the severity of PPPD.

The visual stimulation factor had the widest AUC (0.830) among the three exacerbating factors (Fig. 3). Moreover, the differences in the visual stimulation score between the PPPD and control groups were the most apparent among the three exacerbating factors (Fig. 1B), suggesting that visual stimulation was the most characteristic exacerbating factor. Notably, symptom exacerbation by upright posture/walking was also observed in the control group; therefore, the AUC of this factor was relatively narrow (0.684, Fig. 3). Similar results were reported previously in a congress abstract (10).

Regarding the diagnosing capability of the NPQ, a visual stimulation score of 9 (full score = 24) had the best sensitivity (82%) and specificity (74%) for discriminating PPPD patients from control patients. In addition, total NPQ scores of 27 and 29 (full score = 72) had the best sensitivity (score of 27: 70%; score of 29: 68%) and specificity (score of 27: 68%; score of 29: 70%) for discriminating PPPD patients from control patients. However, care should be taken when using the NPQ to diagnose PPPD. The NPQ does not include questions regarding the core vestibular symptoms (i.e., dizziness, unsteadiness, and nonspinning vertigo) or the time from onset (>3 mo), which must be assessed to diagnose PPPD. This omission was incurred because we wished to develop the NPQ for both diagnosis and the assessment of PPPD severity. The types of vestibular symptoms and the disease duration were not suitable for scoring. We assume that the NPQ may be more useful for diagnosing PPPD in patients with confirmed core vestibular symptoms and a known time from onset.

As another finding of this study, the PPPD patients (49.5 yr, range 25–79 yr) were significantly younger than the control patients (57.3 yr, range 20–82 yr). This is consistent with the findings of a previous report (11) and suggests that PPPD was not an entity of nonspecific age-related disorders. As illustrated in Figure 2B, the anxiety and depression status did not differ between the PPPD and control groups. We have reported that chronic dizziness patients with comorbid psychiatric disorders have more subjective handicaps than those without comorbidities (12). According to the diagnostic criteria, PPPD may coexist with other diseases or disorders (1). Therefore, comorbidities, such as anxiety and depression, could increase the severity of PPPD. However, the current study results suggest that the psychiatric status of PPPD patients was not necessarily more anxious or depressive than that of patients with other vestibular disorders. Thus, PPPD should be clearly discriminated from psychogenic diseases in the diagnosis of chronic dizziness.

Regarding limitations, this was a cross-sectional study that did not include a follow-up period; therefore, we procured no evidence that the questionnaire was sufficiently sensitive to assess the changes in disease severity following treatment. Additionally, we did not control for treatment when enrolling the patients—some patients were enrolled before treatment initiation, while others received medication during the study period. For the patients receiving treatment, the disease severity might have been underestimated and, thus, may have affected the score for the questionnaire. Considering these points, we suggest that the NPQ can be used best as an adjunct to clinical diagnosis; however, it is not a substitute for careful attention to history and differential diagnosis.

In the future, we would like to determine the test–retest reliability of the NPQ and to test the existence of subtypes according to the exacerbating factors using factor analysis.

In conclusion, we developed a questionnaire to aid in PPPD diagnosis and assessment. Among three exacerbating factors, visual stimulation was the most distinctive for PPPD. A visual stimulation factor score of 9 exhibited the best sensitivity (82%) and specificity (74%) for discriminating PPPD from control diseases.

REFERENCES

1. Staab JP, Eckhardt-Henn A, Horii A, et al. Diagnostic criteria for persistent postural-perceptual dizziness (PPPD): Consensus document of the committee for the Classification of Vestibular Disorders of the Barany Society. *J Vest Res* 2017;27:191–208.
2. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiat Scand* 1983;67:361–70.

3. Anastasi A. *Psychological Testing*, 6th ed. New York: Macmillan; 1990.
4. Indovina I, Riccelli R, Chiarella G, et al. Role of the insula and vestibular system in patients with chronic subjective dizziness: An fMRI study using sound-evoked vestibular stimulation. *Front Behav Neurosci* 2015;9:334.
5. Riccelli R, Passamonti L, Toschi N, et al. Altered insular and occipital responses to simulated vertical self-motion in patients with persistent postural-perceptual dizziness. *Front Neurol* 2017;8:529.
6. Nigro S, Indovina I, Riccelli R, et al. Reduced cortical folding in multi-modal vestibular regions in persistent postural perceptual dizziness. *Brain Imaging Behav* 2018;1–12. https://doi.org/10.1007/s11682-018-9900-6.
7. Wurthmann S, Naegel S, Schulte Steinberg B, et al. Cerebral gray matter changes in persistent postural perceptual dizziness. *J Psychosom Res* 2017;103:95–101.
8. Lee JO, Lee ES, Kim JS, et al. Altered brain function in persistent postural perceptual dizziness: A study on resting state functional connectivity. *Hum Brain Mapp* 2018;39:3340–53.
9. Strupp M, Kim JS, Murofushi T, et al. Bilateral vestibulopathy: Diagnostic criteria Consensus document of the Classification Committee of the Bárány Society. *J Vest Res* 2017;27:177–89.
10. Staab J, Eggers S, Neff B, et al. Validation of a clinical syndrome of persistent dizziness and unsteadiness. *J Vest Res* 2010;20:172–3.
11. Yan Z, Cui L, Yu T, et al. Analysis of the characteristics of persistent postural-perceptual dizziness: A clinical-based study in China. *Int J Audiol* 2017;56:33–7.
12. Horii A, Imai T, Kitahara T, et al. Psychiatric comorbidities and use of milnacipran in patients with chronic dizziness. *J Vest Res* 2016;26:335–40.