

# Dizziness handicap and anxiety depression among patients with benign paroxysmal positional vertigo and vestibular migraine

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## Abstract

To investigate the dizziness handicap and anxiety depression among patients with benign paroxysmal positional vertigo (BPPV) and vestibular migraine (VM).

A prospective cohort study in which patients came from the Department of Neurology, Beijing Tiantan Hospital, Capital Medical University was conducted. Patients were diagnosed with BPPV and VM from September 2016 to December 2017. Dizziness handicap inventory (DHI) scale and hospital anxiety and depression scale (HADS) were assessed among subjects before treatment and 3 months follow-up.

We used the Mann–Whitney *U* test to compare the DHI and HADS scores of BPPV and VM patients before and after 3 months and found significantly statistical difference. Before treatment, the median DHI scores of BPPV and VM were 34 and 60, with a  $Z = -5.643$  ( $P = .001$ ); The median HADS scores were 6 and 14, with  $Z = -4.807$  ( $P = .001$ ). After 3 months follow-up, the median DHI scores of BPPV and VM were 0 and 22, with a  $Z = -8.425$  ( $P = .001$ ); The median HADS scores were 6 and 14, with  $Z = -7.126$  ( $P = .001$ ) 51.11% VM patients and 12.21% BPPV patients have anxiety and depression. A Spearman correlation revealed a significantly moderate positive correlation ( $r = .455$ ,  $P < .001$ ) between DHI and HADS scores.

The emotional, functional and physical effects of vertigo on VM patients were more significant than BPPV patients. The change of DHI scores in BPPV and VM patients was positively correlated with changes in the anxiety and depression in the HADS.

**Abbreviations:** BPPV = benign paroxysmal positional vertigo, DHI = dizziness handicap inventory, HADS = hospital anxiety and depression scale, VM = vestibular migraine.

**Keywords:** anxiety, benign paroxysmal positional vertigo, depression, dizziness, vestibular migraine

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All authors declare no conflicts of interest related to the present study.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## 1. Introduction

Dizziness or vertigo is one of the most common complaints in clinical medicine, with a reported lifetime prevalence of approximately 30%.<sup>[1]</sup> Benign paroxysmal positional vertigo (BPPV) is one of the most commonly occurring peripheral vestibular disorders, with a lifetime prevalence of 2.4%.<sup>[2]</sup> This condition is characterized by acute, short attacks of severe dizziness brought about by sudden head movements. Vestibular migraine was first described by Boenheim in 1917,<sup>[3]</sup> and is currently the most common cause of spontaneous vertigo attacks other than BPPV. Its clinical manifestations mainly include paroxysmal vestibular symptoms, which are accompanied by various types of migraines. Vertigo and dizziness increase the risk of falling because of an imbalance caused by impaired movement and space directed damage. Studies have implicated anxiety and depression in vestibular or balance dysfunctions. Particularly, paroxysmal vertigo patients face unforeseeable and sudden onset, which provokes a profound involvement of physical and mental disorders resulting in serious impact on the effect of patients treatment and quality of life. Due to the fear of paroxysmal dizziness or vertigo, patients usually dare not to attempt daily activities, relying on a caregiver, and experience obvious anxiety, depression, and insomnia.

Staab reported that physical neurotologic conditions may trigger psychopathology in a similar fashion to how primary anxiety disorders cause dizziness.<sup>[4]</sup> Hasan Hüseyin<sup>[5]</sup> found that

more than 1/3 BPPV patients had at least 1 mood or anxiety disorder while Ferrari reported a 21.7% mild to moderate depression in patients with BPPV.<sup>[6]</sup> In another study, Sirpa Ketola showed that almost 68% of vertiginous patients encountered a psychiatric problem.<sup>[7]</sup> However, the reciprocal role played by degree of dizziness handicap in vertigo and psychological conditions remains unclear.

The aim of this study was to assess dizziness handicap disorders and anxiety or depression in patients with benign paroxysmal positional vertigo and vestibular migraine. We compared 2 common vertigo diseases to provide potential outcome influence about dizziness handicap disorders and anxiety or depression, which may be helpful to clinical diagnosis and treatment.

## 2. Methods

### 2.1. Patients collection

This clinical study was approved by the Institutional Review Board (IRB) of Beijing Tiantan Hospital, Capital Medical University. These patients in our study only underwent standard treatment and all procedures were performed according to the Declaration of Helsinki guidelines. This study was a prospective cohort study in which patients came from the Department of Neurology, Beijing Tiantan Hospital, Capital Medical University. Patients were diagnosed with BPPV and VM from September 2016 to December 2017. A total of 131 patients with BPPV and 45 patients with VM were enrolled. All participants underwent detailed diagnostic procedures consisting of neurological and neuro-otological examinations, including positioning manoeuvres, electronystagmography, and audiometry examination to exclude Meniere disease and sudden deafness.

### 2.2. Inclusion criteria

Patients with the following conditions were included from the study:

1. The clinical practice guideline on BPPV published by the Barany Association in 2015.<sup>[8]</sup> Patients were treated with the canalith repositioning maneuvers, and those with vertigo attacks due to changes in head position with the abnormal Dix-Hallpike and roll tests results diagnosed with BPPV. The Epley, Barbecue, and Gufoni maneuvers were performed on patients depending on the involved semicircular canal.
2. VM patients were included according to the diagnostic criteria made by the 2012 Barany Association and the International Headache Society<sup>[9]</sup>:
  - A. At least 5 episodes with vestibular symptoms of moderate or severe intensity, lasting 5 minutes to 72 hours.
  - B. Current or previous history of migraine with or without aura according to the International Classification of Headache Disorders (ICHD).
  - C. One or more migraine features with at least 50% of vestibular episodes: headache with at least 2 of the following characteristics: one sided location, pulsating quality, moderate or severe pain intensity, aggravation by routine physical activity photophobia and phonophobia, visual aura.
  - D. Not better accounted for by another vestibular or ICHD diagnosis.
3. Age  $\geq$  18 years old.

4. The BPPV and VM patients were first attack and visited to the hospital for standard guideline recommendation.

### 2.3. Exclusion criteria

Patients with the following conditions were excluded from the study:

1. Any patients with other types of primary or secondary headaches;
2. Patients with incomplete information and did not complete the follow-up;
3. Patients who were undergoing psychotherapy;
4. Patients who had cerebral infraction, cerebral hemorrhage, and multiple sclerosis.

## 3. Measurement indices and follow-up

### 3.1. Measurement scale

Dizziness Handicap Inventory Scale (DHI Scale):<sup>[10]</sup> This scale has a total of 25 questions, which can be used to assess the extent of damage based on emotional, functional, and physical aspects of patients with vertigo. According to the grading standards established by Whitney, patients with a score between 0 and 30 are classified into the minor disorders group, 31 to 60 are categorized as moderate, and those with a score of 61 to 100 are classified into the severe group.

Hospital Anxiety and Depression Scale (HADS):<sup>[11]</sup> The HADS consisted of 14 items, 7 assessing depression and 7 for anxiety. According to the authors criteria, scores across the 2 subscales of anxiety and depression were divided into 0–7, 8–10, and 11–21 points representing asymptomatic, suspicious, and definite symptoms, respectively.

Frequency of Vertigo: never or almost never (0), less than once a month (1), at least once a month (2), once a week (3), 2 to 3 times a week (4), 4 to 6 times a week (5), once a day (6), more than once a day (7), and always (8).

### 3.2. Demographic data and follow-up

Demographic data included age, gender, neurological examination, and patients medication histories. During the assessment, all patients received vestibular function and audiometry examination to exclude Meniere disease and sudden deafness. Finally, 215 patients (BPPV 156, VM 59) were enrolled in this study, with a lost rate of 18.14%. Before treatment, all the patients who met the inclusion criteria were assessed by DHI and HADS scales in hospital with the help of our investigator. After 3 months follow-up, 176 patients completed the DHI and HADS scale assessment. One investigator assessed these patients using the DHI and HADS scales in 3 months with telephone.

### 3.3. Statistical procedures

The Chi-Squared test or Fisher exact test was used to compare the demographic data of patients and the rate of depression and anxiety in 2 groups. There were several data in 3 months follow-up that did not conform to the normal distribution. The Mann-Whitney *U* test was performed for DHI and HADS scores. When  $P < .05$ , the differences between the 2 groups were deemed to be statistically significant. Spearman correlation between dizziness handicap and anxiety or depression variables were tested. All

statistical analyses were performed using the IBM SPSS statistical software version 22.0.

#### 4. Results

##### 4.1. Demographic profile

We enrolled a total of 131 BPPV and 45 VM patients between September 2016 and December 2017. BPPV patients were aged between 24 and 74 years, including 43 males and 88 females, with an average age of  $50.86 \pm 13.47$  years. VM patients were aged between 29 and 72 years, including 13 males and 32 females, with an average age of  $49.00 \pm 12.98$  years. Vertigo in VM patients was spontaneous vertigo and the duration of the attack was 5 to 60 minutes. The frequency of vertigo attacks was 1 to 2 times per month. We observed none statistically significant differences between the 2 groups with regard to gender ( $P = .609$ ) and age ( $P = .498$ ). The median DHI scale in BPPV patients before treatment was 34, while the subscales for each DHI median score was 14, 10, and 10 for function, emotion and body, respectively (Table 1). The HADS median score was 6. In the VM patients, we found a median DHI score of 60, while the subscales for each score were 24, 20, and 16 for function, emotion, and body, respectively (Table 2). The HADS score median was 14, which was significantly higher than the average level of BPPV patients.

##### 4.2. Dizziness handicap and anxiety depression comparison among BPPV and VM patients

DHI and HADS scores of the 176 patients before and after 3 months of treatment were compared and summarized in Table 3. The median DHI scores of BPPV patients before and after 3 months follow-up were 34 and 0, with a  $Z = -9.720$  ( $P < .001$ ) following the Wilcoxon Signed Ranks test. The median HADS scores for BPPV patients before and after 3 months follow-up were 6 and 0, with  $Z = -8.541$  ( $P < .001$ ) after Wilcoxon Signed Ranks test. In VM patients, we recorded median DHI scores of 60

**Table 1**  
DHI and HADS scores of BPPV patients at the baseline, 1 month and 3 months.

Scale	Median	Maximum value	Minimum value	25 percentile	75 percentile
Baseline					
DHI* total scores	34	82	0	20	50
Functional	14	36	0	8	20
Emotional	10	28	0	2	14
Physical	10	32	0	6	16
HADS† scores	6	20	0	3	10
1 month					
DHI total scores	0	50	0	0	4
Functional	0	18	0	0	0
Emotional	0	16	0	0	0
Physical	0	22	0	0	4
HADS scores	0	33	0	0	2
3 months					
DHI total scores	0	46	0	0	0
Functional	0	16	0	0	0
Emotional	0	20	0	0	0
Physical	0	14	0	0	0
HADS scores	0	27	0	0	0

\* DHI = dizziness handicap inventory.  
† HADS = hospital anxiety and depression scale.

**Table 2**  
DHI and HADS scores of VM patients at the baseline, 1 month and 3 months.

Scale	Median	Maximum value	Minimum value	25 percentile	75 percentile
Baseline					
DHI* total scores	60	88	0	44	70
Functional	24	36	0	17	30
Emotional	20	36	0	11	27
Physical	16	28	0	11	23
HADS† scores	14	31	0	6	21
1 month					
DHI total scores	22	70	0	12	31
Functional	8	24	0	4	13
Emotional	6	28	0	4	10
Physical	6	20	0	4	10
HADS scores	7	19	0	2	11
3 months					
DHI total scores	10	46	0	4	16
Functional	4	16	0	2	8
Emotional	2	16	0	0	4
Physical	2	14	0	2	6
HADS scores	3	11	0	0	5

\* BPPV = benign paroxysmal positional vertigo.  
† VM = vestibular migraine.

and 14 before and after 3 months respectively, with  $Z = -5.768$  ( $P < .001$ ) following the Wilcoxon Signed Ranks test. The median HADS scores for this category before and after 3 months were 14 and 3, while the Wilcoxon Signed Ranks test showed  $Z = -5.780$  ( $P < .001$ ). At the same time, we used the Mann-Whitney *U* test to compare the DHI and HADS scores of BPPV and VM patients before and after 3 months and found significant statistical difference. Before treatment, the median DHI scores of BPPV and VM were 34 and 60, with a  $Z = -5.643$  ( $P = .001$ ); The median HADS scores were 6 and 14, with  $Z = -4.807$  ( $P = .001$ ). After 3 months follow-up, the median DHI scores of BPPV and VM were 0 and 22, with a  $Z = -8.425$  ( $P = .001$ ); The median HADS scores were 6 and 14, with  $Z = -7.126$  ( $P = .001$ ). In the 131 patients diagnosed with BPPV, a total of 16 (12.21%) displayed HADS scores  $> 14$ . On the other hand, there were 23 (51.11%) subjects who exhibited HADS scores  $> 14$  in the 45 patients with VM. We observed a higher occurrence of anxiety and depression in female compared to male patients (Table 4). Scores from the DHI scale and each sub-item in patients with anxiety and depression were significantly higher ( $P < .05$ ) than those from patients without these conditions.

##### 4.3. DHI and HADS scores correlation

Spearman correlation performed to analyze the relationship between DHI scores and HADS scores. The change of DHI scores in BPPV patients was positively correlated with changes in the anxiety and depression in the HADS ( $r = .591$ , 95% confidence interval = 0.385–0.762,  $P < .001$ ). The change of DHI scores in VM patients was positively correlated with changes in the anxiety and depression in the HADS ( $r = .556$ , 95% confidence interval = 0.303–0.751,  $P < .001$ ).

#### 5. Discussion

We used the DHI and HADS scale to assess the dizziness handicap and anxiety or depression state of BPPV and VM

**Table 3**  
DHI and HADS scores of patients at the baseline and 3 months.

Scale	BPPV <sup>*</sup> group average rank	VM <sup>†</sup> group average rank	z-value	Mann-Whitney (P-value)	95%CI
Baseline					
DHI <sup>‡</sup> total scores	75.81	125.46	-5.643	.001	37.25–47.61
Functional	77.63	120.14	-4.841	.001	15.56–18.36
Emotional	75.34	126.84	-5.872	.001	9.81–12.49
Physical	79.89	113.57	-3.840	.001	12.09–14.22
HADS <sup>§</sup> scores	76.68	118.52	-4.807	.001	7.74–9.82
3 months					
DHI total scores	72.02	136.48	-8.425	.001	3.19–5.78
Functional	72.91	133.89	-9.042	.001	1.10–2.12
Emotional	75.29	126.96	-8.801	.001	0.73–1.63
Physical	74.84	128.26	-7.062	.001	1.26–2.14
HADS scores	75.12	125.22	-7.126	.001	1.00–2.02

\* BPPV = benign paroxysmal positional vertigo.

† VM = vestibular migraine.

‡ DHI = dizziness handicap inventory.

§ HADS, hospital anxiety and depression scale; CI, confidence interval.

patients before and after 3 months follow-up and found significantly statistical difference. The scores of DHI and its subscales and HADS scale in VM patients were significantly higher than those of patients with BPPV. Patients with VM were most likely to suffer from dizziness handicap, depression, and anxiety. The median scores of DHI for patients with BPPV and VM before treatment were 34 and 60, respectively. According to the grading standard formulated by Whitney, it revealed that the dizziness handicap among BPPV and VM patients were moderate impact disorders. The median HADS score for patients with BPPV and VM before treatment were 6 and 14, respectively. We observed significant differences in vestibular dysfunction before and after treatment during the 3 months of follow-up in terms of DHI and HADS scales in 176 patients. The degree of dizziness handicap and anxiety or depression in BPPV and VM patients improved significantly after treatment. According to HADS score criteria made by Zigmond, scores between 8 and 10 represent suspicious anxiety depression; scores between 11 and 21 points represent definite anxiety depression symptoms. We also found that the change of DHI scores in BPPV and VM patients was positively correlated with changes in the anxiety and depression in the HADS. The more severe the dizziness handicap, the more attention needs to be paid to mental state of the patients. We need to pay more attention to the clinical manifestations and psychological evaluation of VM patients, and adjust the relevant drug treatment in time according to the progress of the disease.

Dizziness or vertigo mainly affects the quality of life of patients in 3 aspects: emotional, functional, and physical. Vertigo attacks

trigger subjective spatial orientation errors, surrounding environment spiraling around, obvious balance dysfunction, and even severe autonomic dysfunction, such as nausea, vomiting, respiratory pulse increasing in patients. In this way, it decreases the ability of patients to operate normally. Vertigo patients manifests emotional problems, such as anxiety and depression which reflect the degree of vertigo. Researchers have found that changes in mood and cognition influence the rehabilitation strategies for vertigo patients. Strong fluctuations of these factors delay the normal physiological compensatory process, which cause discomfort even in intermittent patients.<sup>[12]</sup> The unpredictability of vertigo attacks and its physical symptoms limit the range of motion in patients. For instance, they may actively avoid head movement, going out alone.<sup>[5]</sup> Monoaminergic inputs pervading the vestibular system mediate the effects of anxiety on vestibular function; whereas parabrachial nucleus network regulates emotional responses to disruption of vestibular function.<sup>[13]</sup> Dizziness activates the body's internal threat response system, increasing the patients perception of motor stimulation.<sup>[14]</sup> These outcomes are vase on the autonomic nervous, endocrine and emotional responses of the inferior limbic cortex to various stimuli.<sup>[15]</sup> A study reported almost 20% dizziness patients had high levels of psychological distress. Giuseppe Magliulo reported that 29.2% of the BPPV patients have clinical anxiety and 22% patients walking needs help.<sup>[16]</sup> Yardley reported that almost 29% vertigo patients have anxiety symptom accessed by HADS.<sup>[17]</sup> Psychological factors, such as anxiety and depressive disorders, may affect clinical presentations and therapeutic outcomes in patients with vestibular

**Table 4**  
DHI scores of patients with and without anxiety or depression at the baseline.

Scale	Without anxiety or depression average rank	With anxiety or depression average rank	z-value	Mann-Whitney (P-value)
male	32 (34.78%)	17 (20.23%)	–	.032 <sup>a</sup>
DHI <sup>*</sup> total scores	72.83	105.66	-4.272	.001
Functional	78.46	99.49	-2.742	.006
Emotional	66.54	112.55	-6.004	.001
Physical	79.20	98.69	-2.545	.011

<sup>a</sup>  $\chi^2$  test.

\* VM = vestibular migraine.

and balance complaints. Study shown that there were substantial overlap between the neuroanatomical regions and neurotransmitters involved in the vestibular system and the pathways implicated in emotional states.<sup>[13]</sup>

One study compared the effects of vestibular rehabilitation on VM and tension-type headache patients by Headache Impact Test (HIT-6), DHI, and HADS scale. They found the change in the HIT-6 score was significantly correlated with changes in DHI and HADS-A in VM patients.<sup>[18]</sup> Our study found that the change of DHI scores in VM patients was positively correlated with changes in the anxiety and depression in the HADS. Change of dizziness handicap and anxiety depression impact from baseline to 3 months after treatment in the BPPV and VM group significantly and positively improved. Sinisa Maslovaraa found significant improvement recovery after pharmacotherapy and rehabilitation therapy among BPPV patients by using DHI and HADS scale.<sup>[19]</sup> Vertigo patients suffer from significant distortion of mental state in the form of anxiety or depression. We found that VM patients suffered from more emotional, functional, and physical effects than BPPV patients.

Some limitations should be considered about our study. First, anxiety and depression disorders were only evaluated by a self-reported questionnaire, and no structured interview was administered. More comprehensive assessment scales could be added in future study. Second, due to the small sample size of this study, our results cannot be generalized in patients with dizziness or vertigo. We enrolled these subjects who experienced first acute vertigo attack that may cause selection bias. Different dizziness handicap degree, paroxysmal frequency, and previous dizziness history should be considered as variable factors influencing clinical outcomes. Future prospective research using larger sample sizes is advocated to validate the present findings. Last, this study assessed the patients baseline and outcome for 3 months follow-up. Some patients who evolved into chronic subjective dizziness after 3 months may need longer follow-up to confirm existing residual dizziness or psychological disorders.

## 6. Conclusion

The emotional, functional, and physical effects of vertigo on VM patients were more significant than BPPV patients. After 3 months follow-up, the dizziness handicap and anxiety and depression disorders among VM and BPPV patients have improved. The change of DHI scores in BPPV and VM patients was positively correlated with changes in the anxiety and depression in the HADS.

## Author contributions

**Conceptualization:** Cuiting Zhu.

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**Methodology:** Cuiting Zhu.

**Supervision:** Xingquan Zhao.

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**Writing – review & editing:** Yi Ju, Xingquan Zhao.

## References

- [1] Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *CMAJ* 2003;169:681–93.
- [2] Bhattacharyya N, Gubbels SP, Schwartz SR, et al. Clinical practice guideline: benign paroxysmal positional vertigo (update). *Otolaryngol Head Neck Surg* 2017;156:S1–1.
- [3] Lempert T, Olesen J, Furman J, et al. Vestibular migraine: diagnostic criteria. *Der Nervenarzt* 2013;84:511–6.
- [4] Staab JP, Ruckenstein MJ. Which comes first? Psychogenic dizziness versus otogenic anxiety. *Laryngoscope* 2003;113.
- [5] Nagaratnam N, Ip J, Bou-Haidar P. The vestibular dysfunction and anxiety disorder interface: a descriptive study with special reference to the elderly. *XXXX* 40:253–64.
- [6] Silvia F, Daniele M, Sara B, et al. Vertigo “In the Pink”: the impact of female gender on psychiatric-psychosomatic comorbidity in benign paroxysmal positional vertigo patients. *Psychosomatics* 2014;55.
- [7] Ketola S, Havia M, Appelberg B, et al. Psychiatric symptoms in vertiginous patients. *Nord J Psychiatry* 2014;69.
- [8] Friscia LA, Morgan MT, Sparto PJ, et al. Responsiveness of self-report measures in individuals with vertigo, dizziness, and unsteadiness. *Otol Neurotol* 2014;35:884–8.
- [9] Lempert T, Olesen J, Furman J, et al. Vestibular migraine: diagnostic criteria. *J Vestib Res* 2012;22:167–72.
- [10] Chen W, Shu L, Wang Q, et al. Validation of 5-item and 2-item questionnaires in Chinese version of Dizziness Handicap Inventory for screening objective benign paroxysmal positional vertigo. *Neurol Sci* 2016;37:1241–6.
- [11] Zigmond A, Snaith R. The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica* 1983;67:361–70.
- [12] Meli A, Zimatore G, Badaracco C, et al. Effects of vestibular rehabilitation therapy on emotional aspects in chronic vestibular patients. *J Psychosom Res* 2007;63:0–190.
- [13] Goddard M, Zheng Y, Darlington CL, et al. Monoamine transporter and enzyme expression in the medial temporal lobe and frontal cortex following chronic bilateral vestibular loss. *Neurosci Lett* 2008;437:107–10.
- [14] Jacob RG, Furman JM. Psychiatric consequences of vestibular dysfunction. *Curr Opin Neurol* 2001;14:41–6.
- [15] Ruckenstein MJ, Staab JP. Chronic subjective dizziness. *Otolaryngol Clin North Am* 2009;42:71–7.
- [16] Magliulo G, Bertin S, Ruggieri M, et al. Benign paroxysmal positional vertigo and post-treatment quality of life. *Eur Arch Otorhinolaryngol* 2005;262.
- [17] Yardley L. A longitudinal study of symptoms, anxiety and subjective well-being in patients with vertigo. *Clin Otolaryngol Allied Sci* 1994;19:109.
- [18] Sugaya N, Arai M, Goto F. Is the headache in patients with vestibular migraine attenuated by vestibular rehabilitation? *Front Neurol* 2017;8:124.
- [19] Sinisa M, Silva BS, Mirjana P, et al. Benign Paroxysmal Positional Vertigo (BPPV): influence of pharmacotherapy and rehabilitation therapy on patients’ recovery rate and life quality. *NeuroRehabilitation* 2012;31:435–41.