BRITISH JOURNAL OF HOSPITAL MEDICINE

ARTICLE

The Impact of Nurse-Led Motivational Interviewing Based on the Transtheoretical Model on Benign Paroxysmal Positional Vertigo Patients: A Retrospective Study

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Abstract

Aims/Background Benign paroxysmal positional vertigo (BPPV) is a common vestibular disorder with a high recurrence rate. Motivational interviewing (MI), a patient-centred communication technique, combined with the transtheoretical model (TTM), may be crucial in promoting behavioural changes and reducing recurrence in BPPV patients. Therefore, this study evaluated the effects of nurse-led MI based on the TTM on rehabilitation outcomes and recurrence rates in BPPV patients.

Methods This retrospective cohort study included 1143 BPPV patients treated at Beijing Shijitan Hospital, Capital Medical University, China, between October 2021 and April 2024. The study group (n = 510) received MI based on the TTM in addition to standard BPPV treatment, while the control group (n = 633) received only standard treatment. Data were collected on patients' quality of life (using the Dizziness Handicap Inventory [DHI]), self-care ability (using the Exercise of Self-Care Agency [ESCA] scale), self-efficacy (using the General Self-Efficacy Scale [GSES]), health-promoting lifestyle (using the Health-Promoting Lifestyle Profile [HPLP]), and recurrence rate over the one month of treatment.

Results We observed that the study group and the control group were comparable in terms of age, education level, occupational category, underlying chronic diseases other than hyperlipidemia, and there were no significant differences in baseline characteristics ($p > 0.05$). Post-intervention, the study group demonstrated significantly lower DHI scores, indicating improved quality of life and reduced functional disability ($p < 0.001$). Self-care ability ($p < 0.001$) and self-efficacy ($p < 0.001$) were substantially higher in the study group. HPLP, particularly for physical activity, was significantly enhanced. The recurrence rate was significantly lower in the study group (7.06% vs 12.48%, $p = 0.002$), with group allocation emerging as an independent predictor of recurrence. Logistic regression analysis confirmed that group allocation was an independent predictor of recurrence ($p = 0.002$).

Conclusion Nurse-led MI based on the TTM significantly improves the quality of life, self-care ability, self-efficacy, and health-promoting lifestyle in BPPV patients while effectively reducing recurrence rates. This approach demonstrates potential clinical significance in the long-term management of BPPV patients.

Key words: benign paroxysmal positional vertigo; motivational interviewing; transtheoretical model; quality of life

Submitted: 24 September 2024 Revised: 24 January 2025 Accepted: 20 February 2025

How to cite this article:
Wang H, Wang F, Ren L, Li Y. The Impact of Nurse-Led Motivational Interviewing Based on the Transtheoretical Model on Benign Paroxysmal Positional Vertigo Patients: A Retrospective Study. Br J Hosp Med. 2025. https://doi.org/10.12968/hmed.2024.0692

Introduction

Benign paroxysmal positional vertigo (BPPV) is a common peripheral vestibular disorder caused by the displacement of otoconia into the semicircular canals.

When otoconia disrupts vestibular receptors, patients experience brief but intense vertigo episodes triggered by changes in head movements, often accompanied by nausea, vomiting, and imbalance (Kim et al, 2021). BPPV is particularly prevalent among the elderly, affecting approximately 2.4% of the general population and 9% of the elderly at least once in their lifetime (Casani and Gufoni, 2023). Moreover, it includes a lifetime prevalence of 2.4%, a 1-year prevalence of 1.6%, and a 1-year incidence of 0.6% (Sfakianaki et al, 2021; von Brevern et al, 2007), underscoring its public health significance.

BPPV frequently disrupts daily activities, severely affects the quality of life and increases the risk of falls, particularly among elderly patients, potentially resulting in fractures and other complications (Hyland et al, 2024; Lindell et al, 2021). Additionally, BPPV has a high recurrence rate, with one study indicating that 67.3% of patients experience a recurrence within two years after treatment (Teggi et al, 2021). The high recurrent BPPV increases healthcare costs and exerts a significant psychological burden, elevating anxiety and stress associated with the unpredictable nature of vertigo episodes.

The primary treatment for BPPV includes canalith repositioning maneuvers, such as the Epley maneuver, along with vestibular rehabilitation (Ribeiro et al, 2017). While these approaches are usually effective in alleviating symptoms, the higher recurrence rate of this condition limits the long-term efficacy of one-time treatments. To decrease the recurrence rate, clinical management typically includes patient education, lifestyle modifications, and long-term rehabilitation exercises; however, there is still limited research on their effectiveness. Moreover, existing management strategies face several challenges. Many patients lack awareness of the disease or the motivation for prevention, resulting in poor adherence to rehabilitation exercises or healthy lifestyle changes, ultimately increasing the risk of recurrence (Fu et al, 2020).

Motivational interviewing (MI) is a patient-centred communication approach designed to encourage behavioural change by improving intrinsic motivation. It is widely used in chronic disease management and lifestyle interventions (Miller, 2023). This method relies on patient autonomy, using supportive dialogue to enhance their self-management capabilities and assist patients in setting realistic health goals (Emery and Wimmer, 2025). In recent years, MI has been widely applied across various diseases, demonstrating significant effects in chronic disease management and rehabilitation. Studies have reported its efficacy in improving health behaviours, including increasing physical activity, improving dietary habits, and reducing recurrence risks (Frost et al, 2018; Seven et al, 2023). Therefore, MI could be crucial in BPPV management by enhancing patient understanding of the disease, boosting engagement in rehabilitation, and ultimately reducing recurrence rates.

The transtheoretical model (TTM) is a psychological framework that describes behaviour change as a multiple-stage process, comprising pre-contemplation, contemplation, preparation, action, and maintenance (Raihan and Cogburn, 2023). It emphasizes that behaviour change is dynamic, with individuals experiencing various challenges and requiring different levels of support at each stage. TTM is commonly used in health behaviour interventions, enabling healthcare providers to

determine a patient's readiness for change and offer tailored guidance. In disease management and prevention, TTM has proven to be an effective tool, particularly when integrated with other interventions, such as MI, to enhance behaviour change (de Freitas et al, 2020; Li et al, 2020). The combination of MI and TTM helps identify a patient's stage in the behavior change process, and provides personalized communication and support, making interventions more effective. Recent research has explored TTM-based MI in chronic disease management, indicating its advantages. For instance, it has been observed that this method can significantly alleviate depressive symptoms in coronary heart disease patients, enhancing cognitive and behavioural outcomes, and improving self-efficacy (Li et al, 2020).

This retrospective study evaluates the impact of nurse-led MI based on the TTM on the rehabilitation outcomes of BPPV patients. Specifically, it seeks to assess the role of MI in promoting health-promoting lifestyles, improving self-care ability and self-efficacy, and alleviating recurrence rates. This study intends to provide evidence to support personalized management strategies for BPPV in the future. Additionally, by combining MI and TTM, this study addresses a critical gap in current BPPV management, emphasizing long-term patient engagement and adherence to rehabilitation practices. The potential benefits of this approach could transform BPPV care, and the findings of this study could contribute to a more patient-centred strategy, ultimately enhancing care and reducing recurrence rates.

Methods

Study Design

A retrospective study design was used to analyze the impact of nurse-led MI based on the TTM on BPPV patient outcomes.

Recruitment of Study Participants

The study recruited BPPV patients who received treatment at Beijing Shijitan Hospital, Capital Medical University, China, using pre-determined inclusion criteria as follows: (1) Patients diagnosed with BPPV following the updated American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) Clinical Practice Guideline (Bhattacharyya et al, 2017); (2) patients received canalith repositioning treatment as their initial treatment; (3) patients underwent only a single repositioning treatment; (4) patients aged 18 years or above; (5) patients able to understand the study and agree to participate; (6) patients had complete clinical records. However, the individuals meeting the following conditions were excluded: (1) patients with ineffective repositioning treatment; (2) those with severe internal or surgical conditions; (3) patients with advanced tumours; (4) patients with other serious inner ear or neurological conditions; (5) those had recurrent BPPV with prior repositioning therapy; (6) patients with cupulolithiasis; (7) secondary BPPV patients; (8) those intolerant to repositioning therapy.

Using the hospital's electronic medical records system, 1328 BPPV patients who received treatment between October 2021 and April 2024 were selected. Based on the pre-determined inclusion-exclusion criteria, 1143 patients were included in

the final study cohort. However, 120 patients were excluded due to undergoing two repositioning treatments or having incomplete clinical records, while 65 were excluded for having cupulolithiasis. After that, the patients were divided into two groups based on whether they received MI intervention: the control group (n = 633) and the study group (n = 510).

Routine Care				
Includes regular health education, medication management, and basic health guidance. Nursing measures emphasize the execution of standardized treatment plans with regular support and supervision.				
Rehabilitation Exercises				
Goal	**Exercise**	**Description**	**Frequency**	**Duration**
Enhance gaze stability	Eye tracking exercises	Track a moving small object (e.g., a pen)	Twice a day	Five minutes each time
	Fixed gaze exercises	Focus on a fixed point while keeping the head still	Twice a day	One minute on each side
	Stable tracking exercises	Move the eyes to follow a target while keeping the head still	Twice a day	Two minutes each time
Enhance postural stability	Single-leg stand	Attempt to stand on one leg, gradually increasing the time	Three times a day	Ten to thirty seconds each time
	Eyes-closed standing	Stand with eyes closed, gradually reducing support to enhance proprioception	Twice a day	Ten to twenty seconds each time
	Straight walking exercises	Walk along a straight line while maintaining a stable posture	Twice a day	Two minutes each time
	Turning exercises	Slowly turn in a safe environment, gradually increasing the turning speed	Twice a day	One to two minutes each time
Reduce dizziness and vertigo	Head position change exercises	Practice in different head positions, such as from sitting to standing	Twice a day	Three to five minutes each time
	Body rotation exercises	Perform body rotation exercises with support	Twice a day	Two minutes each time
	Repeated exposure	Gradually expose oneself to positions or movements that trigger dizziness to reduce the response	Once or twice a day	Five minutes each time
Enhance daily activity capability	Standing up and sitting down	Stand up and sit down from a chair to simulate daily actions	Three times a day	Five to ten times each time
	Stair training	Go up and down stairs to enhance balance in daily activities	Once a day	One to two minutes up and down
	Activities of daily living simulation	Simulate daily activities such as shopping and cleaning a room, gradually increasing the difficulty	Three to four times a week	Fifteen to thirty minutes each time

Fig. 1. Otolith repositioning procedure and rehabilitation training content.

Treatment and Care Protocols

To maintain the internal validity of the study, all patients received standard treatment for BPPV, with the only difference being the intervention. This approach enables precise assessment of the intervention's impact on patient outcomes. Furthermore, to control potential confounding variables, propensity score matching was employed to ensure both groups were comparable regarding age, gender, and duration of BPPV. This matching process reduces biases and ensures that any observed differences in outcomes were attributed to the intervention rather than other external factors.

Control Group Treatment

Patients in the control group, identified through medical records, received standard BPPV treatment, which included canalith repositioning maneuvers, standard rehabilitation training, and routine care. Fig. 1 summarizes the specific contents used in standard care and rehabilitation training. Standard care was initiated immediately following hospital admission and diagnosis confirmation. Routine care included health education, medication management, and basic rehabilitation guidance. The Epley maneuver was conducted for patients with posterior canal BPPV,

while the Lempert maneuver was used for those with horizontal canal BPPV. Rehabilitation training involved improving gaze stabilization, enhancing postural stability, reducing dizziness and vertigo, and restoring daily activities to help patients recover their balance. After the first rehabilitation session, a recorded video of the exercises was provided to patients to guide continued practice at home. Each rehabilitation session lasted for approximately 30 minutes, with sessions conducted twice weekly for a one-month duration. Furthermore, standard care guidance and follow-up appointments were scheduled bi-weekly to monitor progress without additional MI or specialized counselling.

Study Group Treatment

Patients in the study group received the transtheoretical model (TTM)-based nurse-led MI in addition to standard BPPV treatment and routine care. The MI intervention was initiated within one week of standard BPPV treatment to ensure a consistent baseline for measuring the incremental effects of the additional intervention. Trained nurses performed MI sessions after the canalith repositioning maneuver, with each lasting for 30–45 minutes, and conducted twice weekly for a one-month period. The TTM-based MI involved three main phases such as preparation, implementation, and follow-up (Fig. 2).

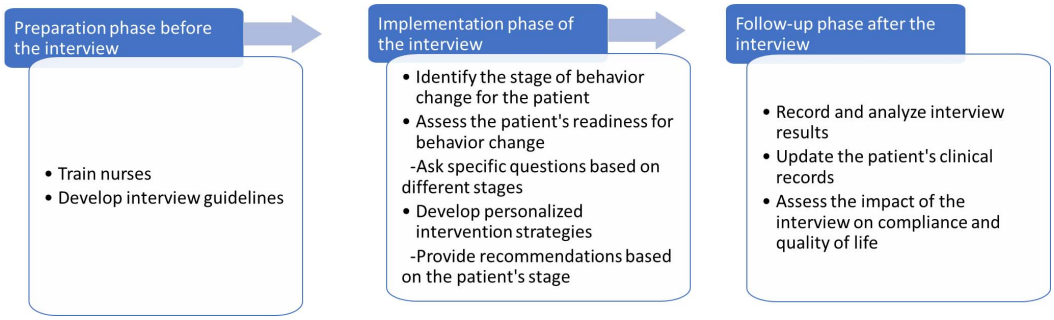

Fig. 2. Stages of motivational interviewing in the transtheoretical model.

Preparation Phase

During this phase, nurses underwent training and interview guidelines were developed to ensure consistency and effectiveness. They were trained in MI techniques and the core principles of the TTM, integrating theoretical sessions with practical role-playing exercises to improve their skills.

Implementation Phase

As shown in Fig. 3, the implementation phase involved the following five stages, each addressing different aspects of behavioural change:

• Pre-contemplation Stage: This stage aims to improve disease awareness while gaining insights into the patient's perspective on their condition. Open-ended questions were used to evaluate the patient's knowledge of BPPV and its impact on their daily life.

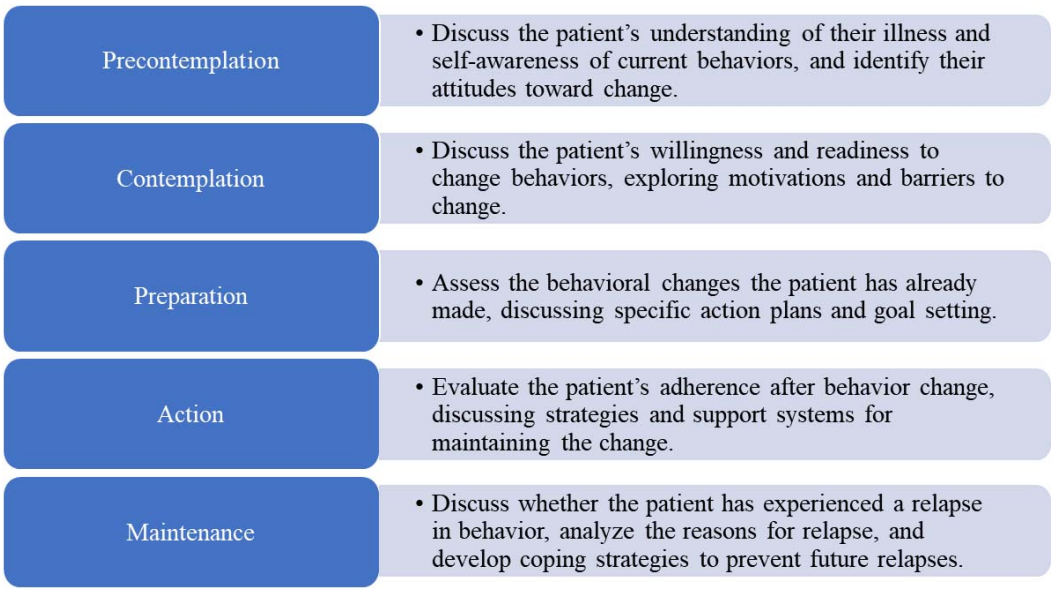

Fig. 3. Motivational interviewing stages in the transtheoretical model and interview content.

• Contemplation Stage: At this stage, the willingness of the patients to change was assessed. Nurses guided them in weighing the pros and cons of adopting behaviour changes for BPPV management, encouraging them to recognize the benefits of making positive adjustments.

• Preparation Stage: Action plans were developed during this stage. Nurses collaborate with patients to set realistic goals and identify specific steps for effective management of their condition. Personalized strategies were developed based on each patient's needs and circumstances.

• Action Stage: This stage aims to sustain behaviour change. Nurses helped patients implement their action plans while addressing any challenges they encountered. Positive reinforcement and problem-solving approaches were used to help maintain progress and motivation.

• Maintenance Stage: Methods for managing relapses were addressed, focusing on maintaining progress and preventing regression. Nurses encouraged patients to adopt healthy behaviours and provided resources for continued support. Each session, lasting 30–45 minutes, was conducted by trained nurses with skills in MI and TTM. The frequency of the sessions was personalized to the patient's progress and needs, typically occurring from weekly to bi-weekly over six weeks.

Follow-Up Phase

This phase involved monitoring patient outcomes and evaluating the effectiveness of the interviews. Nurses documented patient progress, identifying improvements and challenges encountered during the intervention. These data were used to adjust future sessions and improve the overall impact of the program.

This standardized MI approach was designed to promote behavioural changes, ultimately enhancing patient's ability to manage BPPV symptoms, and improving their quality of life.

Data Collection

Data Source

Data were retrieved from the electronic medical record system, including patient demographics, diagnostic records, treatment plans, rehabilitation outcome evaluations, and MI records. Psychological and functional evaluation was conducted by trained healthcare professionals specializing in neuropsychological assessments and rehabilitation outcomes. Specifically, licensed psychologists and certified rehabilitation therapists, who had undergone rigorous training and certification, were responsible for administering and scoring these assessments. To ensure accuracy and reliability, all assessments followed standardized protocols.

Data Variables

Baseline Characteristics

The collected baseline characteristics included the patient's age, gender, education level, occupation type, chronic conditions (such as rhinitis, allergic diseases, and chronic insomnia), BPPV type, and clinical symptoms.

Rehabilitation Outcome

Based on the 2017 evaluation criteria developed by the Chinese Society of Otolaryngology-Head and Neck Surgery for assessing BPPV efficacy (Editorial Board of Chinese Journal of Otorhinolaryngology Head and Neck Surgery and Society of Otorhinolaryngology Head and Neck Surgery Chinese Medical Association, 2017), outcomes were categorized into three categories: (1) complete resolution of both nystagmus and vertigo (cured), (2) significant reduction in nystagmus and vertigo (effective), and (3) no significant improvement in nystagmus and vertigo (ineffective). Immediate assessment results were documented after the initial treatment.

Quality of Life and Functional Disability

The Dizziness Handicap Inventory (DHI) (Jacobson and Newman, 1990) was used to assess the quality of life and functional disability of patients with dizziness. The DHI involves 25 items across three dimensions, with each item scored from 0 to 4. The functional dimension assesses the impact of dizziness on daily activities, the emotional dimension evaluates the psychological effects, and the physical dimension assesses physical limitations. The total score ranges from 0 to 100, with scores of 0–30 indicating mild impairment, 31–60 moderate impairment, and over 60 severe impairment. The scale had Cronbach's α of 0.90.

Self-Care Ability

The Exercise of Self-Care Agency (ESCA) scale (Kearney and Fleischer, 1979) was used to assess an individual's self-care ability. The ESCA includes 43 items covering health knowledge, self-care skills, responsibility for self-care, and self-concept. Each item is scored on a scale from 0 to 4, with a maximum score of 172. Higher scores indicate greater self-care capacity. The Cronbach's α for this scale was 0.93.

Self-Efficacy

The confidence of an individual in managing various challenges was assessed using the General Self-Efficacy Scale (GSES) (Luszczynska et al, 2005). It includes 10 items, each scored from 1 to 4, with a total score ranging from 10 to 40. Higher scores indicate greater self-efficacy. GSES demonstrated the Cronbach's α of 0.87.

Lifestyle

Health-promoting behaviours were determined using the Health-Promoting Lifestyle Profile (HPLP) (Walker et al, 1987), which involves 52 items across six dimensions: health responsibility, nutrition, physical activity, stress management, interpersonal relations, and spiritual growth. Each item is scored on a scale from 1 to 4, with a total score ranging from 52 to 208. Higher scores reflect more active health-promoting behaviours. The Cronbach's α for the HPLP was 0.80.

Recurrence

A one-month follow-up was conducted using the Roll maneuver and Dix-Hallpike test to assess BPPV recurrence. For the Roll maneuver, the patients were placed in a supine position with their heads elevated 30°, and their heads were turned 90° to one side until vertigo or nystagmus subsided. After waiting 20 seconds, patients were returned to 90° to the opposite side for observation. The Dix-Hallpike test was performed by having patients sit up, then lying down with their heads turned 45° to one side while keeping it stationary, observing for any dizziness and nystagmus. This follow-up was performed once per month (Editorial Board of Chinese Journal of Otorhinolaryngology Head and Neck Surgery and Society of Otorhinolaryngology Head and Neck Surgery Chinese Medical Association, 2017).

Data Analysis

Data were analyzed using SPSS version 26.0 (IBM, Armonk, NY, USA), and all tables and figures were generated using Microsoft Word 2016 software (Microsoft, Seattle, WA, USA) and PowerPoint 2016 software (Microsoft, Seattle, WA, USA). Initially, the data were assessed for normality using either the Shapiro-Wilk test or the Kolmogorov-Smirnov test. The p-value is greater than 0.05, indicating a normal distribution. Quantitative data following a normal distribution was analyzed using an independent t-test, comparing the difference in the mean between the two groups. For quantitative data that did not follow a normal distribution, the Mann-Whitney U test was used to compare the median difference between the two groups. Qualitative data (e.g., sex, disease status, etc.) were expressed as frequencies and percentages, with Chi-square tests used to compare the percentage differences between different groups. To compare data before and after the intervention, an appropriate paired test was selected based on the normality of the data. If the data before and after the intervention followed a normal distribution, the paired t-test was used to compare the changes. If the data before and after the intervention did not follow a normal distribution, the Wilcoxon sign-rank test was used to compare pre- and post-intervention changes.

To assess the effect size, Cohen's d statistic was used to measure the extent of the difference in the means between the two groups. A value below 0.2 indicates small effects, a value between 0.2 and 0.8 indicates moderate effects, and a value above 0.8 indicates large effects. Based on previous research, which identified only variables with statistically significant associations in univariate analysis, it became apparent that this approach might neglect the impact of certain variables on outcomes (Stone et al, 2011; Xu, 2016).

Therefore, in line with clinical experience and prior research findings, this study used a multivariate logistic regression model that incorporated all variables to investigate the relationship between recurrence and TTM-based MI. Specifically, chronic conditions and clinical symptoms were treated as dummy variables in the analysis. All statistical analyses were two-sided, with a p-value < 0.05 considered statistically significant.

Results

Comparison of Basic Information Between the Two Groups

We observed that the study group and the control group were comparable in terms of age, education level, occupational category, underlying chronic diseases other than hyperlipidemia, and there were no significant differences in baseline characteristics ($p > 0.05$), indicating a good balance between them. Specifically, the average age was comparable between the groups, with no significant differences in educational status. Similarly, insignificant differences were observed in the distribution of occupation categories and chronic conditions. Moreover, there were no statistically significant differences between the two groups in terms of BPPV type and clinical symptoms (such as vertigo, nausea, and imbalance) ($p > 0.05$), revealing a good balance in these key characteristics and providing a strong foundation for subsequent analysis (Table 1).

Comparison of Repositioning Treatment Efficacy Between the Two Groups

As shown in Table 2, there were no statistically significant differences between the study and control groups regarding the immediate effectiveness of repositioning treatment. The cure rate was 81.6% in the study group and 81.3% in the control group, with no significant difference between the groups ($p = 0.928$). Similarly, the effective rate did not differ significantly between the two groups, with the study group exhibiting an 18.4% effective rate compared to 18.7% in the control group.

Comparison of Quality of Life and Functional Disability Between the Two Groups

After the intervention, significant differences were found between the study and control groups in the four measures of Emotional domain of the Dizziness Handicap Inventory (DHI-E) ($p < 0.001$), Functional domain of the Dizziness Handicap Inventory (DHI-F) ($p < 0.001$), Physical domain of the Dizziness Handicap Inventory (DHI-P) ($p < 0.001$), and Total score of the Dizziness Handicap Inventory (DHI-T) ($p < 0.001$). Before the intervention, there were no significant differences between the two groups for the DHI-F and DHI-P indicators ($p = 0.261$ and 0.871,

Table 1. Comparison of general demographic indicators between the two groups.

Variable	Study group (n = 510)	Control group (n = 633)	t/χ^2	p-value
Age	55.2 ± 8.1	55.5 ± 8.3	0.614	0.540
Gender			14.257	<0.001
Male	176 (34.5%)	154 (24.3%)		
Female	334 (65.5%)	479 (75.7%)		
Education level			0.260	0.878
High school or below	280 (54.9%)	355 (56.1%)		
Associate/bachelor's degree	155 (30.4%)	191 (30.2%)		
Master's degree or above	75 (14.7%)	87 (13.7%)		
Occupational category			1.039	0.308
Employed	390 (76.5%)	500 (78.9%)		
Retired	120 (23.5%)	133 (21.1%)		
Chronic conditions				
Rhinitis	98 (19.2%)	112 (17.7%)	0.436	0.509
Allergic diseases	75 (14.7%)	93 (14.9%)	0.000	0.995
Chronic insomnia	58 (11.4%)	72 (11.4%)	0.000	0.999
Hypertension	72 (14.1%)	96 (15.2%)	0.248	0.619
Diabetes	56 (11.0%)	60 (9.5%)	0.699	0.403
Hyperlipidemia	95 (18.6%)	77 (12.2%)	9.229	0.002
Others	17 (3.3%)	24 (3.8%)	0.171	0.679
Type of BPPV			2.102	0.551
Left posterior semicircular canal	152 (29.8%)	207 (32.7%)		
Right posterior semicircular canal	212 (41.6%)	253 (39.9%)		
Left horizontal semicircular canal	72 (14.1%)	95 (15.0%)		
Right horizontal semicircular canal	74 (14.5%)	78 (12.3%)		
Clinical symptoms				
Vertigo	490 (96.1%)	600 (94.8%)	1.066	0.302
Nausea	130 (25.5%)	150 (23.7%)	0.491	0.483
Imbalance	280 (54.9%)	320 (50.5%)	2.142	0.143
Others	51 (10.0%)	64 (10.1%)	0.004	0.951

Note: BPPV, Benign paroxysmal positional vertigo.

respectively). However, after the intervention, the study group scored significantly lower on these indicators than the control group ($p < 0.001$).

For the DHI-T index, the difference between the two groups before the intervention was insignificant ($p = 0.177$), but after the intervention, the study group score was significantly lower than that of the control group ($p < 0.001$, Table 3).

Comparison of Self-Care Ability Between the Two Groups

Before the intervention, there were no significant differences between the study and control groups regarding health literacy levels, self-care skills, and self-care responsibility scores, suggesting that both groups had similar base levels. However, after the intervention, the study group exhibited significantly higher scores than the control group across all assessment measures ($p < 0.001$, Table 4).

Table 2. Comparison of repositioning treatment efficacy between the two groups.

Variable	Study group (n = 510)	Control group (n = 633)	χ^2	*p*-value
Cured	416 (81.6%)	515 (81.3%)	0.008	0.928
Effective	94 (18.4%)	118 (18.7%)		

Table 3. Comparison of quality of life and functional impairment between the two groups.

Measure	Group	Control group (n = 633)	Study group (n = 510)	Z	*p*-value
DHI-E	Before intervention	17.00 (14.00, 19.00)	16.00 (14.00, 18.00)	2.627	0.009
	After intervention	3.00 (1.00, 5.00) *	0.00 (0.00, 2.00) *	18.551	<0.001
DHI-F	Before intervention	19.00 (16.00, 22.00)	19.00 (16.00, 21.25)	1.123	0.261
	After intervention	2.00 (1.00, 3.00) *	1.00 (1.00, 1.00) *	12.236	<0.001
DHI-P	Before intervention	14.00 (11.00, 17.00)	14.00 (10.00, 18.00)	0.163	0.871
	After intervention	3.00 (2.00, 4.00) *	1.00 (1.00, 2.00) *	13.638	<0.001
DHI-T	Before intervention	49.00 (44.00, 55.00)	49.00 (43.00, 54.00)	1.351	0.177
	After intervention	8.00 (6.00, 11.00) *	3.00 (2.00, 5.00) *	21.331	<0.001

Note: DHI-E, Emotional domain of the Dizziness Handicap Inventory; DHI-F, Functional domain of the Dizziness Handicap Inventory; DHI-P, Physical domain of the Dizziness Handicap Inventory; DHI-T, Total score of the Dizziness Handicap Inventory. * vs Before intervention in the same group, $p < 0.05$.

Comparison of Self-Efficacy Between the Two Groups

Before the intervention, the mean value was 25.23 ± 6.57 in the control group and 25.48 ± 6.35 in the study group. However, the difference was statistically insignificant ($p = 0.516$). After the intervention, a significant difference was observed in the mean values between the study (27.94 ± 6.40) and control groups (32.11 ± 5.13) ($p < 0.001$, Table 5).

Analysis of Health-Promoting Lifestyle

Before the intervention, there were no significant differences between the two groups regarding health responsibilities, nutrition, physical activity, stress management, relationships, and spiritual growth, suggesting that these health-related behaviours and cognitions were similar at baseline. However, after the intervention, the study group showed significant improvements in health responsibility, physical activity, stress management, and overall scores. Particularly, in physical activity, the study group scored significantly higher than the control group (22.28 ± 2.72 vs 17.83 ± 3.04, $p < 0.001$). This finding suggests that the intervention was effective in increasing physical activity levels. Additionally, the study group exhibited significant improvements in health responsibility (24.53 ± 2.97 vs 21.03 ± 3.25, $p < 0.001$) and total score (140.68 ± 9.01 vs 132.57 ± 9.41, $p < 0.001$). Moreover, the study group was also superior to the control group in stress management ($p = 0.023$, Table 6).

Table 4. Comparison of Exercise of Self-Care Agency (ESCA) scores between the two groups.

Measure	Group	Control group (n = 633)	Study group (n = 510)	*t*	*p*-value
Health knowledge level	Before intervention	62.32 ± 9.73	62.57 ± 9.16	0.459	0.647
	After intervention	72.81 ± 10.01*	85.23 ± 7.83*	22.134	<0.001
Self-care skills	Before intervention	26.61 ± 4.54	26.44 ± 4.31	–0.892	0.373
	After intervention	33.54 ± 4.62*	40.36 ± 4.28*	25.676	<0.001
Self-care responsibility	Before intervention	13.01 ± 4.72	13.29 ± 4.22	1.043	0.298
	After intervention	15.29 ± 4.05*	19.54 ± 3.91*	17.857	<0.001
Total score	Before intervention	101.94 ± 11.53	102.31 ± 10.67	0.565	0.572
	After intervention	121.64 ± 11.64*	145.13 ± 9.79*	36.352	<0.001

Note: * vs Before intervention in the same group, $p < 0.05$.

Table 5. Comparison of General Self-Efficacy Scale (GSES) scores between the two groups.

Group	Control group (n = 633)	Study group (n = 510)	*t*	*p*-value
Before intervention	25.23 ± 6.57	25.48 ± 6.35	0.650	0.516
After intervention	27.94 ± 6.40*	32.11 ± 5.13*	11.957	<0.001

Note: * vs Before intervention in the same group, $p < 0.05$.

Comparison of Recurrence Rate Between the Two Groups

During the one-month follow-up, 115 patients experienced recurrence, with a BPPV recurrence rate of 10.06%. Specifically, 36 (7.06%) patients in the study group experienced recurrence, compared to 79 (12.48%) in the control group. The difference in recurrence rates between the two groups was statistically significant ($\chi^2 = 9.174$, $p = 0.002$, Table 7). Furthermore, univariate binary logistic regression analysis was performed using recurrence as the dependent variable and baseline characteristics as independent variables. The results revealed that group ($p = 0.003$), age ($p = 0.040$), rhinitis ($p = 0.001$), chronic insomnia ($p = 0.034$), nausea ($p = 0.047$), and imbalance ($p = 0.004$) were significantly associated with recurrence (Table 8). Based on the significant variables identified in the univariate analysis, a multivariate regression model was developed, demonstrating group (Odds Ratio [OR] = 0.511, 95% Confidence Interval [CI]: 0.336–0.777) as an independent predictor of recurrence (Table 9).

Discussion

This retrospective study analyzed the impact of MI based on the TTM on the rehabilitation outcomes of patients with BPPV. The results indicate that MI based on TTM not only significantly affects the recurrence rate of BPPV but also shows significant advantages in improving health-related lifestyle, self-care ability, and self-efficacy. These findings offer novel strategies for the effective management of BPPV.

Table 6. Comparison of Health-Promoting Lifestyle Profile (HPLP) scores between the two groups.

Item	Group	Control group (n = 633)	Study group (n = 510)	*t*	*p*-value
Health responsibility	Before intervention	19.31 ± 3.11	19.22 ± 3.36	0.473	0.636
	After intervention	21.03 ± 3.25*	24.53 ± 2.97*	18.731	<0.001
Nutrition	Before intervention	20.54 ± 3.38	20.16 ± 3.21	1.964	0.050
	After intervention	21.85 ± 3.46*	22.04 ± 3.09*	0.959	0.338
Physical activity	Before intervention	16.99 ± 2.91	17.06 ± 2.85	0.459	0.646
	After intervention	17.83 ± 3.04*	22.28 ± 2.72*	25.688	<0.001
Stress management	Before intervention	21.57 ± 3.26	21.33 ± 3.14	1.298	0.195
	After intervention	21.72 ± 3.37	22.15 ± 3.09*	2.273	0.023
Interpersonal relations	Before intervention	26.23 ± 3.05	25.88 ± 2.95	1.952	0.051
	After intervention	26.15 ± 3.19	25.94 ± 2.83	1.171	0.242
Spiritual growth	Before intervention	23.84 ± 4.22	23.42 ± 4.02	1.710	0.088
	After intervention	23.98 ± 4.28	23.74 ± 4.27	0.947	0.344
Total score	Before intervention	128.48 ± 8.99	127.06 ± 9.16	2.624	0.009
	After intervention	132.57 ± 9.41*	140.68 ± 9.01*	14.758	<0.001

Note: * vs Before intervention in the same group, $p < 0.05$.

Table 7. Comparison of recurrence rate between the two groups.

Recurrence	Study group (n = 510)	Control group (n = 633)	χ^2	*p*-value
Yes	36 (7.06%)	79 (12.48%)	9.174	0.002
No	474 (92.94%)	554 (87.52%)		

Quality of Life and Functional Impairment

We observed that MI significantly improved the quality of life and reduced functional impairment in BPPV patients. This result aligns with a previous meta-analysis conducted by Uzun and Gürhan (2024), demonstrating similar benefits for patients with chronic diseases. This improvement can be attributed to MI's emphasis on enhancing patient autonomy and self-management, which encourages them to actively engage in their healthcare.

Self-Care Ability and Self-Efficacy

Moreover, this study demonstrated that the intervention group had significantly higher self-care ability and self-efficacy scores compared to the control group. By boosting patient autonomy and self-management, MI effectively enhanced self-efficacy, which aligns with the findings of Farley (2019). They highlighted that by increased self-efficacy encourages patients to actively engage in their treatment,

Table 8. Univariate binary logistic regression analysis for examining recurrence rate.

Variable	β	SE	Wald	Significance	OR	95% CI	
						Lower limit	Upper limit
Group (reference: Control group)	–0.630	0.211	8.948	0.003	0.533	0.352	0.805
Age	0.025	0.012	4.211	0.040	1.025	1.001	1.050
Gender (reference: Male)	0.057	0.219	0.068	0.794	1.059	0.689	1.627
Education (reference: High school and below)	0.047	0.134	0.123	0.726	1.048	0.806	1.363
Occupational category (reference: Retired)	–0.083	0.241	0.119	0.730	0.920	0.573	1.477
Rhinitis (reference: Yes)	0.709	0.22	10.341	0.001	2.032	1.319	3.130
Allergic diseases (reference: Yes)	–0.533	0.329	2.630	0.105	0.587	0.308	1.118
Chronic insomnia (reference: Yes)	–0.564	0.266	4.492	0.034	0.569	0.338	0.958
Hypertension (reference: Yes)	–0.240	0.298	0.647	0.421	0.787	0.438	1.412
Diabetes (reference: Yes)	–0.604	0.403	2.249	0.134	0.546	0.248	1.204
Hyperlipidemia (reference: Yes)	–0.270	0.298	0.822	0.365	0.763	0.426	1.369
Others (reference: Yes)	–0.035	0.536	0.004	0.947	0.965	0.338	2.758
Types of otolithiasis (reference: Right posterior semicircular canal/Left posterior semicircular canal/Left horizontal semicircular canal/Right horizontal semicircular canal)	0.084	0.097	0.749	0.387	1.088	0.899	1.317
Vertigo (reference: Yes)	–0.329	0.530	0.385	0.535	0.720	0.255	2.033
Nausea (reference: Yes)	–0.421	0.213	3.928	0.047	0.656	0.432	0.995
Imbalance (reference: Yes)	–0.586	0.205	8.127	0.004	0.557	0.372	0.833
Other (reference: Yes)	–0.416	0.289	2.070	0.150	0.659	0.374	1.163

Note: CI, Confidence Interval; OR, Odds Ratio.

Table 9. Multivariate binary logistic regression analysis for assessing recurrence rate.

Variable	β	SE	Wald	Significance	OR	95% CI	
						Lower limit	Upper limit
Group (reference: Control group)	–0.672	0.214	9.879	0.002	0.511	0.336	0.777
Age	0.023	0.012	3.578	0.059	1.024	0.999	1.049
Rhinitis (reference: Yes)	–0.486	0.236	4.244	0.039	0.615	0.387	0.977
Chronic insomnia (reference: Yes)	–0.441	0.280	2.469	0.116	0.644	0.372	1.115
Nausea (reference: Yes)	–0.210	0.235	0.800	0.371	0.811	0.512	1.284
Imbalance (reference: Yes)	–0.458	0.226	4.123	0.042	0.633	0.407	0.984

ultimately resulting in better outcomes. Therefore, our findings support the integration of MI into BPPV rehabilitation treatment to enhance self-care ability and self-efficacy, optimizing overall management. The primary objective of MI is to increase patient engagement and self-management by improving intrinsic motivation (Bischof et al, 2021). Furthermore, MI supports the development of personalized self-care plans by establishing a collaborative therapeutic relationship and improving self-efficacy, significantly fostering self-care abilities. These findings align with existing evidence reported by Dellafiore et al (2023), demonstrating that MI effectively improves self-care abilities and enhances disease management. Additionally, Masterson Creber et al (2016) revealed that self-care improvement gained through MI has long-lasting effects on chronic disease management. Our findings further validate the effectiveness of MI in improving self-care abilities among BPPV patients.

Health-Promoting Lifestyle Profile (HPLP)

The HPLP results revealed that patients in the intervention group scored significantly higher in health responsibility, nutrition, exercise, and stress management compared to the control group. However, no significant differences were found between the two groups in spiritual growth and interpersonal relationships. These observations are consistent with the theoretical framework of MI, which emphasises improving self-efficacy and promoting behavioural change. By fostering a trusting relationship with patients and enhancing intrinsic motivation, MI encourages positive health behaviours. This approach not only helps patients identify and set personal health goals but also enhances self-efficacy through supportive dialogue and reinforcement of autonomous decision-making (Dobber et al, 2021).

Furthermore, the significant improvements observed in health responsibility, nutrition, and exercise among the intervention group suggest that MI effectively promoted patients to adopt and maintain a healthier lifestyle. These findings are supported by previous research. For instance, Cole et al (2023) reported that MI significantly facilitates lifestyle changes, enhancing self-management and elevating awareness of disease prevention. Similarly, Smriti et al (2022) found that MI encouraged self-reflection and motivated patients to adopt healthier dietary habits.

Although the intervention group showed significant improvements in health responsibility, nutrition, exercise, and stress management, no significant changes

were found in spiritual growth and interpersonal relationships. This may be due to the specific focus and strategies of the MI intervention, and the study's time limitations. However, short-term interventions are more effective in promoting changes in health-related behaviours, including dietary choices, exercise habits, and stress management. Conversely, improvements in spiritual growth and interpersonal relationships often need deeper psychological transformation and sustained social interactions, which may require longer-term interventions and additional support. Therefore, the timeframe of this study may not have been sufficient to fully capture the potential long-term benefits of MI in these areas.

Recurrence Rate

Our findings demonstrated a significantly lower recurrence rate in the intervention group than in the control group, supporting the theoretical basis of MI. By increasing intrinsic motivation and self-efficacy, MI allows for better disease management, thereby reducing recurrence risk. These findings align with previous findings, for example, Oveisi et al (2020) reported significantly reduced recurrence rates following MI interventions in patients with chronic diseases. Similarly, Wheeler et al (2023) revealed a positive impact of MI on relapse prevention by enhancing patient adherence. These findings highlight the effectiveness of MI in reducing the risk of recurrence, as we observed in this study.

The mechanism underlying MI's effect likely operates through several pathways. First, by enhancing self-efficacy, MI enables patients to better manage their diseases more effectively, thereby reducing the likelihood of recurrence. Second, MI supports the development of positive lifestyle and self-care practices, which contribute to long-term disease management and alleviate recurrence risk.

Comparison With Other Studies

While our study underscores the efficacy of MI in BPPV management, it is vital to compare these results with similar investigations. Previous research has shown that MI is effective in managing various chronic conditions, including diabetes, hypertension, and obesity. For instance, Rubak et al (2005) revealed that MI significantly improved glycemic control in diabetic patients, emphasizing its potential across different chronic conditions. Our study adds to this body of evidence by revealing MI's effectiveness in BPPV, further supporting its applicability in improving patient engagement and self-management across various chronic diseases.

Clinical Implementation Recommendations

To effectively implement MI in BPPV management, we recommend the following strategies:

• Healthcare Professional Training: Equip healthcare providers with comprehensive training to ensure its practical application in clinical settings.

• Integration with Standard Treatments: Combine MI with standard medical treatments for BPPV management, such as the Epley maneuver or canalith repositioning, to optimize overall outcomes.

• Continuous Support and Follow-Up: Establish structured follow-up sessions to monitor progress, provide constant support, and reinforce positive behavioural changes.

• Multidisciplinary Approach: Incorporate psychological support and exercise therapy alongside MI to address both the physical and psychological aspects of BPPV management.

By adopting these strategies, healthcare providers can enhance the effectiveness of BPPV management, improve patient outcomes, and minimize the risk of recurrence.

It is crucial to address the limitations of this study, including its relatively short duration and potential variability in interviewer consistency, highlighting the need for further research to fully assess the long-term effects of MI on spiritual growth, interpersonal relationships, and overall patient outcomes. Future studies should extend the intervention duration to comprehensively evaluate these long-term effects. Furthermore, due to hurdles in data availability and the specific focus of this research, we did not assess how disease duration or the number of repositioning maneuvers influence prognosis and recurrence rates. However, to address these gaps, future research will specifically focus on collecting detailed data regarding the duration of BPPV symptoms before treatment, the frequency and type of repositioning maneuvers performed, and other relevant clinical parameters. This strategy will facilitate a more nuanced investigation into how these factors impact both short-term and long-term outcomes in BPPV patients. Additionally, exploring the cultural adaptability of MI and its application in diverse patient groups will be crucial for enhancing its generalizability. Similarly, future research should focus on designing prospective studies that incorporate more diverse intervention strategies and validate findings across different cultural contexts. Furthermore, optimizing the intervention by increasing follow-up frequency or extending its duration could provide valuable insights into improving patient satisfaction and outcomes. To achieve these goals, specific research plans should be developed, ensuring a structured and practical strategy to enhance the efficacy of MI in managing chronic conditions like BPPV. Lastly, while our study demonstrates the effectiveness of nurse-led MI based on the TTM in improving rehabilitation outcomes for BPPV patients, it is essential to evaluate the applicability of these findings across different healthcare settings, particularly in resource-limited regions such as the UK.

This study, conducted in China, provides valuable insights into BPPV management that may apply to other regions of the world. However, it is crucial to acknowledge that implementing MI interventions requires significant resource allocation, which can pose challenges for healthcare systems limited with resources. Particularly, nurse-led MI involves specialized training, time-consuming interventions, and continuous follow-up, all of which require substantial investment in personnel and infrastructure. In the UK healthcare system, the successful implementation of MI based on TTM may be hindered by insufficient investment in healthcare providers' training and necessary follow-up care. Additionally, the economic costs associated with such programs may restrict their widespread adoption, particularly in areas with limited healthcare budgets. Therefore, while the benefits of MI-based

interventions are evident, future research should focus on exploring the feasibility of implementing these interventions across various healthcare settings, including those with limited resources. Comparative studies assessing MI outcomes in both resource-rich and resource-limited settings would provide valuable insights into how these interventions can be adapted to different healthcare infrastructures. Furthermore, investigating the cost-effectiveness of MI-based interventions across diverse healthcare settings would help determine their applicability and long-term sustainability.

Conclusion

This retrospective analysis explored the impact of MI based on the TTM on the rehabilitation outcomes of BPPV patients. MI significantly reduced the recurrence rate of BPPV and offered substantial advantages in improving patients' health-related lifestyle, self-care ability, and self-efficacy. These findings underscore the effectiveness of MI in the comprehensive management of BPPV and suggest its application in the rehabilitation of BPPV and other diseases to optimize overall patient care strategies. Future studies should focus on extending the intervention duration and accounting for additional potential confounders to further validate the long-term efficacy of MI.

Key Points

- Motivational interviewing based on the transtheoretical model significantly improved the quality of life of BPPV patients.
- Patients in the intervention group exhibited significant improvements in their self-care abilities.
- We observed a substantial increase in self-efficacy among BPPV patients who underwent MI based on TM.
- Patients in the intervention group showed significant enhancement in health-promoting lifestyle scores.
- MI based on the TM significantly reduced the BPPV recurrence rate.

Availability of Data and Materials

All data included in this study are available from the corresponding author upon reasonable request.

Author Contributions

HW and FW designed the study; all authors conducted the study; HW and LR collected and analyzed the data. HW and YL participated in drafting the manuscript, and all authors contributed to the critical revision of the manuscript for important intellectual content. All authors gave final approval of the version to be published. All authors participated fully in the work, took public responsibility for appropriate

portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work were appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Beijing Shijitan Hospital, Capital Medical University (Approval No.: IIT2023-028-001). This study was performed in accordance with the principles of the Declaration of Helsinki. Informed consent has been obtained from all participants involved in the study.

Acknowledgement

Not applicable.

Funding

The research was supported by the Youth Foundation of Beijing Shijitan Hospital, Capital Medical University (2023-q36).

Conflict of Interest

The authors declare no conflict of interest.

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