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The Role of Vestibular Rehabilitation in the Treatment of Benign Paroxysmal Positional Vertigo in Brazil: A Randomized Controlled Trial

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A B S T R A C T

Introduction: Benign paroxysmal positional vertigo (BPPV) is a prevalent vestibular disorder causing recurrent episodes of vertigo. Vestibular rehabilitation (VR) is a recognized treatment for BPPV, but its effectiveness in the Brazilian population remains to be fully elucidated. This randomized controlled trial aimed to investigate the impact of VR on BPPV outcomes in Brazil. **Methods:** 120 participants diagnosed with BPPV were randomly assigned to either a VR group (n=60) or a standard medical care (SMC) group (n=60). The VR group received a personalized program comprising canalith repositioning maneuvers (CRM) and vestibular exercises, while the SMC group received medication and lifestyle advice. The primary outcome was the Dizziness Handicap Inventory (DHI) score at 4 weeks. Secondary outcomes included vertigo frequency and intensity (assessed via a Vertigo Diary) and balance function (measured using the Timed Up and Go (TUG) test). Assessments were conducted at baseline, 2 weeks, and 4 weeks. **Results:** Both groups showed improvement in DHI scores over time. However, the VR group demonstrated significantly greater improvement in DHI scores at 4 weeks compared to the SMC group ($p<0.05$). Vertigo frequency and intensity also decreased significantly in both groups, with the VR group exhibiting a more pronounced reduction ($p<0.05$). Similarly, TUG test performance improved in both groups, but the VR group showed significantly better improvement at 4 weeks ($p<0.05$). **Conclusion:** This study provides evidence supporting the effectiveness of VR in treating BPPV in the Brazilian population. VR, incorporating CRM and vestibular exercises, resulted in significant improvements in dizziness-related handicap, vertigo symptoms, and balance function compared to SMC alone. These findings underscore the importance of integrating VR into BPPV management in Brazil.

1. Introduction

Benign paroxysmal positional vertigo (BPPV) stands as a prevalent and often debilitating disorder within the realm of neurotology, significantly impacting the lives of individuals across the globe. Characterized by sudden, intense episodes of vertigo triggered by specific head movements, BPPV arises from the dislodging of otoconia, tiny calcium carbonate crystals residing within the utricle of the inner ear. These errant otoconia migrate into one or more of the semicircular canals, typically the posterior canal, disrupting the delicate balance of the vestibular system and generating the unsettling sensation of the world spinning. The clinical presentation of BPPV is marked by its episodic nature, with vertigo spells lasting from seconds to minutes, often accompanied by nausea, vomiting, and a sense of imbalance. These episodes are characteristically provoked by changes in head position, such as lying down, rolling over in bed, tilting the head back, or looking up. The unpredictable

and recurrent nature of these attacks can significantly curtail an individual's ability to perform daily activities, leading to limitations in work, social interactions, and overall quality of life. Furthermore, the fear of experiencing these episodes can induce anxiety and contribute to social isolation, exacerbating the burden of the disease. The prevalence of BPPV is substantial, with estimates suggesting that it affects approximately 2.4% of the general population at some point in their lives. While it can occur across all age groups, the incidence of BPPV rises with age, becoming increasingly common in older adults. This age-related increase is likely attributable to a combination of factors, including age-related degeneration of the vestibular system, a higher prevalence of comorbidities that can predispose to BPPV, and an increased susceptibility to falls.[1-3]

The pathophysiology of BPPV centers on the displacement of otoconia from their normal location within the utricle into the semicircular canals. This displacement can arise from various factors, including head trauma, inner ear infections, and age-related changes in the inner ear. Once within the canals, these free-floating otoconia, now termed canaliths, respond to gravity and head movements, generating abnormal fluid flow and stimulating the sensory hair cells within the affected canal. This aberrant stimulation leads to a mismatch between the signals from the affected ear and the other ear, resulting in the perception of vertigo. The diagnosis of BPPV rests primarily on a thorough clinical evaluation, including a detailed history and a series of provocative maneuvers designed to elicit the characteristic nystagmus, an involuntary rhythmic eye movement, associated with BPPV. The Dix-Hallpike maneuver, a specific head positioning test, is the gold standard for diagnosing posterior canal BPPV, while the roll test is used to assess for lateral canal involvement. These maneuvers induce a transient vertigo spell and a characteristic nystagmus, confirming the diagnosis and identifying the affected canal. While the natural course of BPPV can be variable, many individuals experience spontaneous resolution of symptoms within weeks or months. However, a significant proportion of patients continue to experience recurrent episodes, necessitating intervention to alleviate symptoms and improve quality of life. Vestibular rehabilitation (VR) has emerged as a cornerstone in the management of BPPV, offering a non-invasive and effective approach to address the underlying vestibular dysfunction.[4-6]

VR encompasses a range of therapeutic interventions aimed at reducing dizziness, improving balance, and promoting central nervous system adaptation. In the context of BPPV, VR primarily involves two key components: canalith repositioning maneuvers (CRM) and vestibular exercises. CRM are specifically designed to guide the displaced otoconia back into the utricle, restoring the normal mechanics of the inner ear. The Epley maneuver is the most widely employed CRM for posterior canal BPPV, while the Semont maneuver is utilized for lateral canal BPPV. These maneuvers involve a sequence of precise head movements, leveraging gravity to direct the canaliths out of the affected canal and back into the utricle. When performed correctly, CRM can provide immediate relief from vertigo symptoms, often resolving the BPPV episode in a single session. Vestibular exercises complement CRM by promoting central nervous system adaptation and enhancing balance control. These exercises typically involve repetitive head and body movements, gradually exposing the individual to provoking stimuli and facilitating habituation, a process by which the brain learns to suppress the abnormal vestibular signals. Vestibular exercises can also improve gaze stability, postural control, and overall balance confidence, further contributing to the recovery process.[7,8]

The efficacy of VR in the treatment of BPPV has been well-established in numerous studies conducted across diverse populations. However, the effectiveness of VR may vary across different cultural and geographical contexts due to factors such as healthcare access, adherence to treatment, and genetic predispositions. In Brazil, while VR is increasingly recognized as a valuable treatment modality, research specifically evaluating its effectiveness in the Brazilian population remains limited.[9,10] This randomized controlled trial aimed to address this gap in knowledge by investigating the role of VR in the treatment of BPPV in a Brazilian

population. We hypothesized that VR, incorporating both CRM and vestibular exercises, would result in superior outcomes compared to standard medical care (SMC) alone. SMC typically involves medication for symptomatic relief and lifestyle advice, but it does not actively address the underlying vestibular dysfunction.

2. Methods

This investigation adhered to a rigorous methodological framework designed to elucidate the role of vestibular rehabilitation (VR) in treating benign paroxysmal positional vertigo (BPPV) within the Brazilian population. The study employed a randomized controlled trial design, the gold standard for evaluating treatment efficacy, ensuring the minimization of bias and maximizing the reliability and generalizability of the findings.

The study was conducted at a leading tertiary referral center for otorhinolaryngology in Brazil, renowned for its expertise in the diagnosis and management of vestibular disorders. This setting provided access to a large and diverse patient population, ensuring the recruitment of a representative sample of individuals with BPPV. Prior to the commencement of the study, ethical approval was obtained from the institutional review board, ensuring adherence to all relevant ethical guidelines and regulations. All participants were provided with a comprehensive explanation of the study procedures, potential risks and benefits, and were required to provide written informed consent before enrollment.

Participants were recruited from the outpatient clinic of the otorhinolaryngology department. To be eligible for inclusion in the study, individuals had to meet the following criteria; Age: 18 years or older, ensuring cognitive maturity and the ability to comprehend study procedures; BPPV Diagnosis: A definitive clinical diagnosis of BPPV, confirmed by a positive Dix-Hallpike test, which elicits the characteristic nystagmus associated with posterior canal BPPV; Informed Consent: Capacity to understand and provide voluntary informed consent, ensuring ethical participation. Exclusion criteria were carefully defined to minimize the influence of confounding factors and ensure the homogeneity of the study population. Individuals were excluded if they presented with; Other Vestibular Disorders: Presence of other vestibular conditions, such as Meniere's disease or vestibular neuritis, which could confound the assessment of VR efficacy; Central Nervous System Disorders: History of neurological conditions, such as stroke or multiple sclerosis, which could affect balance and complicate the interpretation of results; Musculoskeletal Limitations: Significant musculoskeletal impairments affecting balance, which could interfere with the assessment of VR-related improvements; Medical Contraindications: Severe medical conditions contraindicating VR, safeguarding participant safety; Pregnancy: To avoid any potential risks to the developing fetus.

Following a thorough screening process and confirmation of eligibility, a total of 120 participants were enrolled in the study. To ensure the comparability of the treatment groups, participants were randomly assigned to either the VR group or the standard medical care (SMC) group using a computer-generated randomization sequence. This process employed a 1:1 allocation ratio, ensuring an equal distribution of participants between the two groups. While the nature of the interventions precluded blinding of the participants and therapists, outcome assessors were blinded to the treatment allocation, minimizing potential bias in the evaluation of treatment outcomes.

The two treatment arms of the study, VR and SMC, were meticulously designed to represent distinct approaches to BPPV management.

Participants assigned to the VR group received a comprehensive and individualized VR program tailored to their specific needs and limitations. This program comprised two key components; Canalith Repositioning Maneuvers (CRM): The cornerstone of VR for BPPV, CRM aimed to reposition the displaced otoconia back into the utricle. The specific maneuver employed was determined by the affected canal, with the Epley maneuver being the treatment of choice for posterior canal BPPV and the Semont maneuver for lateral canal BPPV; Epley Maneuver: This maneuver involves a sequence of four head positions, each held

for approximately 30 seconds, designed to guide the otoconia through the posterior canal and back into the utricle; Semont Maneuver: This maneuver, also involving a series of head movements, is employed for lateral canal BPPV, facilitating the return of otoconia to the utricle. CRM were performed by experienced vestibular therapists, ensuring correct technique and maximizing treatment efficacy. Each session involved performing the chosen CRM up to three times, or until the participant reported complete resolution of vertigo symptoms. In addition to CRM, participants were prescribed a personalized home exercise program comprising a variety of vestibular exercises aimed at promoting central nervous system adaptation and enhancing balance control. These exercises included; Gaze Stabilization Exercises: Designed to improve the coordination of eye and head movements, reducing dizziness and enhancing visual fixation during head motion; Habituation Exercises: Involving repetitive movements that provoke mild symptoms, these exercises aimed to desensitize the vestibular system and reduce the intensity and frequency of vertigo episodes; Balance Training Exercises: Aimed at improving postural stability and balance confidence, these exercises involved challenging balance tasks, such as standing on one leg or walking on uneven surfaces. Participants were provided with detailed instructions on how to perform the exercises correctly and were encouraged to practice them twice daily for the duration of the 4-week intervention period. Regular monitoring and feedback were provided by the therapists to ensure proper technique and adherence to the exercise program.

Participants in the SMC group received standard medical care, which focused on symptomatic relief and general lifestyle advice. This included; Medication: Prescription of medications commonly used to manage vertigo symptoms, such as antihistamines or antiemetics, providing temporary relief from nausea and dizziness; Lifestyle Advice: Education on lifestyle modifications to minimize BPPV symptoms, such as avoiding triggering head positions and movements, ensuring a safe environment to prevent falls, and managing anxiety associated with the condition. This approach represented the conventional management of BPPV, providing a comparative baseline against which to evaluate the efficacy of VR.

To objectively assess the effectiveness of the interventions, a comprehensive set of outcome measures was employed, capturing various dimensions of BPPV impact and recovery. The primary outcome measure was the DHI score at 4 weeks. The DHI is a widely used and validated 25-item self-report questionnaire that quantifies the impact of dizziness on daily activities. Each item is scored on a scale of 0 to 4, with higher scores indicating greater disability. The DHI provides a comprehensive assessment of the functional, emotional, and social consequences of dizziness, capturing the overall impact of BPPV on an individual's quality of life. To track changes in vertigo symptoms over time, participants were asked to maintain a detailed Vertigo Diary. This diary allowed for the systematic recording of the frequency and intensity of vertigo episodes experienced throughout the study period. Vertigo intensity was rated on a numerical scale from 0 to 10, with 0 representing no vertigo and 10 representing the most severe vertigo imaginable. This subjective measure provided valuable insights into the day-to-day experience of BPPV and the impact of interventions on symptom control. The Timed Up and Go (TUG) test was employed to objectively assess balance function. The TUG test is a simple and reliable measure of functional mobility, evaluating the time taken for an individual to stand up from a chair, walk 3 meters, turn around, walk back to the chair, and sit down. This test captures elements of balance, gait, and motor control, providing a quantifiable measure of balance performance and its responsiveness to intervention.

To capture the trajectory of recovery and the effects of the interventions over time, assessments were conducted at three distinct time points; Baseline: Prior to the initiation of any intervention, providing a baseline measure of symptom severity and functional limitations; 2 Weeks: An interim assessment to monitor early changes and track the progress of recovery; 4 Weeks: The primary endpoint of the study, allowing for the evaluation of the long-term effects of the interventions. This longitudinal assessment strategy provided a comprehensive picture of the

recovery process and the differential impact of VR and SMC on BPPV outcomes.

The collected data were meticulously analyzed using SPSS software (version 26), a powerful statistical package widely employed in healthcare research. Descriptive statistics were utilized to summarize participant characteristics and baseline data, providing a clear overview of the study population. To compare baseline characteristics between the VR and SMC groups, the independent samples t-test was used for continuous variables, while the chi-squared test was employed for categorical variables. This analysis ensured the comparability of the two groups at the outset, minimizing the potential for selection bias. Repeated measures analysis of variance (ANOVA) was conducted to compare the change in outcome measures over time between the two groups. This robust statistical method allowed for the assessment of treatment effects while accounting for within-subject variability and the repeated nature of the measurements. Statistical significance was set at a p-value of less than 0.05, indicating a less than 5% probability that the observed differences between the groups were due to chance alone.

3. Results

Table 1 presents the demographic and baseline characteristics of the 120 participants enrolled in the randomized controlled trial, divided into two groups, the vestibular rehabilitation (VR) group and the standard medical care (SMC) group. The two groups were similar in terms of age, gender, affected ear, affected canal, symptom duration, and baseline Dizziness Handicap Inventory (DHI) score. This similarity is crucial as it indicates successful randomization, minimizing the potential for confounding factors to influence the results. The lack of significant differences between the groups at baseline strengthens the internal validity of the study, allowing for a more confident attribution of any observed differences in outcomes to the interventions themselves. The mean age of participants was around 54 years in both groups, with a range spanning from 22 to 81 years. This suggests that the study captured a broad age range, reflecting the typical demographic of individuals with BPPV. The distribution of females was similar between the two groups, with approximately two-thirds of participants being female. This aligns with the known epidemiology of BPPV, which tends to affect women more frequently than men. The majority of participants had right ear involvement and posterior canal BPPV, which is the most common presentation of this condition. The similar distribution of affected ear and canal between the groups further supports the effectiveness of the randomization process. The average symptom duration was around 3 weeks in both groups, indicating a relatively recent onset of BPPV symptoms. This suggests that the participants were likely experiencing their first episode of BPPV or had limited prior experience with the condition. The mean baseline DHI score was around 42 in both groups, indicating a moderate level of dizziness-related handicap. This highlights the significant impact of BPPV on daily activities and quality of life, underscoring the need for effective interventions.

Table 2 presents the mean Dizziness Handicap Inventory (DHI) scores over time for both the Vestibular Rehabilitation (VR) group and the Standard Medical Care (SMC) group. The DHI is a 25-item self-assessment questionnaire that measures the impact of dizziness on daily activities, with higher scores indicating greater perceived handicap. Both the VR and SMC groups showed improvement in DHI scores over time, indicating that both interventions had a positive impact on dizziness-related handicaps. This suggests that even standard medical care, including medication and lifestyle advice, can provide some relief from the functional limitations associated with BPPV. The VR group consistently demonstrated lower DHI scores compared to the SMC group at all time points. This difference became more pronounced at 4 weeks, suggesting that VR led to a significantly greater improvement in dizziness-related handicaps compared to SMC alone. This finding supports the hypothesis that a more active approach to treatment, incorporating canalith repositioning maneuvers and vestibular exercises, is more effective in reducing the impact of BPPV on daily life. The VR group showed a substantial reduction in DHI score from 42.5 at

baseline to 28.5 at 4 weeks. This indicates a clinically meaningful improvement in perceived handicap, suggesting that VR can effectively alleviate the burden of BPPV and improve the overall quality of life for individuals with this condition.

Table 1. Demographic and baseline characteristics of participants.

Characteristic	Vestibular Rehabilitation (VR) Group (n=60)	Standard Medical Care (SMC) Group (n=60)	p-value
Age (years)			
Mean ± SD	53.8 ± 13.2	54.6 ± 12.4	0.72
Range	22-78	25-81	
Gender			
Female, n (%)	41 (68.3)	40 (66.7)	0.84
Affected ear			
Right, n (%)	32 (53.3)	29 (48.3)	0.58
Left, n (%)	28 (46.7)	31 (51.7)	
Affected canal			
Posterior, n (%)	52 (86.7)	55 (91.7)	0.31
Horizontal, n (%)	8 (13.3)	5 (8.3)	
Symptom duration (weeks)			
Mean ± SD	3.2 ± 2.1	2.8 ± 1.8	0.35
Range	1-12	1-10	
Baseline DHI score			
Mean ± SD	42.5 ± 12.8	43.8 ± 13.5	0.61
Range	18-72	21-76	

SD, standard deviation; DHI, Dizziness Handicap Inventory.

Table 2. DHI scores over time.

Time	VR Group (Mean DHI Score)	SMC Group (Mean DHI Score)
Baseline	42.5 ± 12.8	43.8 ± 13.5
2 weeks	35.0 ± 11.5	39.0 ± 12.1
4 weeks	28.5 ± 10.2	35.6 ± 11.8

Table 3 provides valuable insights into the changes in vertigo frequency and intensity over time for both the vestibular rehabilitation (VR) group and the standard medical care (SMC) group. These measures capture the core symptoms of BPPV, reflecting the frequency of vertigo episodes and their subjective severity. Both the VR and SMC groups exhibited a clear reduction in both vertigo frequency and intensity over time. This suggests that both interventions, to some extent, contributed to alleviating the cardinal symptoms of BPPV. This is not unexpected, as the natural course of BPPV often involves spontaneous improvement over time. Additionally, medications provided to the SMC group may offer symptomatic relief. While both groups improved, the VR group consistently demonstrated a more substantial reduction in both vertigo frequency and intensity at all time points. This difference became particularly noticeable at 4 weeks, where the VR group reported significantly lower frequency and intensity of vertigo compared to the SMC group. This finding underscores the superior effectiveness of VR in actively managing BPPV symptoms. By addressing the underlying cause of BPPV through canalith repositioning maneuvers and promoting central compensation through vestibular exercises, VR appears to facilitate a more rapid and complete resolution of vertigo. The VR group experienced a dramatic reduction in vertigo frequency

from 10.2 episodes at baseline to 3.5 episodes at 4 weeks. Similarly, vertigo intensity decreased significantly from 7.5 to 3.1 on the 10-point scale. This marked improvement highlights the effectiveness of VR in not only reducing the frequency of vertigo attacks but also mitigating their severity, leading to a substantial improvement in quality of life.

Table 3. Vertigo frequency and intensity.

Time	VR Group (Mean Vertigo Frequency)	SMC Group (Mean Vertigo Frequency)	VR Group (Mean Vertigo Intensity)	SMC Group (Mean Vertigo Intensity)
Baseline	10.2 ± 4.5	10.8 ± 4.8	7.5 ± 2.1	7.8 ± 2.3
2 weeks	6.8 ± 3.8	8.5 ± 4.1	5.2 ± 1.8	6.1 ± 2.0
4 weeks	3.5 ± 2.9	5.1 ± 3.5	3.1 ± 1.5	4.0 ± 1.8

Table 4 presents the results of the timed up and go (TUG) test, a measure of functional mobility, in both the Vestibular Rehabilitation (VR) group and the Standard Medical Care (SMC) group over time. The TUG test assesses the time taken to stand up from a chair, walk 3 meters, turn around, walk back, and sit down, reflecting an individual's balance and motor control. Both the VR and SMC groups showed improvement in TUG test performance over time, as evidenced by the decrease in mean TUG test times. This suggests that both interventions had a positive impact on functional mobility and balance, likely due to a combination of natural recovery and, in the SMC group, potential benefits from medication and lifestyle advice. The VR group consistently demonstrated shorter TUG test times compared to the SMC group at all time points. This difference became more pronounced at 4 weeks, indicating that VR led to significantly greater improvement in functional mobility compared to SMC alone. This finding supports the notion that actively engaging in vestibular rehabilitation exercises enhances balance control and facilitates a more efficient recovery of motor skills. The VR group showed a substantial reduction in TUG test time from 12.5 seconds at baseline to 9.8 seconds at 4 weeks. This improvement reflects a clinically meaningful enhancement in functional mobility, suggesting that VR can effectively improve balance and reduce the risk of falls in individuals with BPPV.

Table 4. Timed up and go (TUG) test.

Time	VR Group (Mean TUG Test Time)	SMC Group (Mean TUG Test Time)
Baseline	12.5 ± 2.8	13.1 ± 3.2
2 weeks	11.0 ± 2.5	12.0 ± 2.9
4 weeks	9.8 ± 2.1	11.2 ± 2.6

4. Discussion

The dizziness handicap inventory (DHI) is a cornerstone in evaluating the impact of dizziness on an individual's life. It's more than just a score, it's a window into how dizziness interferes with daily activities, emotional well-being, and overall quality of life. In this study, the DHI played a crucial role in demonstrating the effectiveness of vestibular rehabilitation (VR) in improving the lives of individuals with benign paroxysmal positional vertigo (BPPV). Developed in 1990 by Jacobson and Newman, the DHI is a 25-item self-assessment questionnaire that quantifies the perceived handicap imposed by dizziness. The functional subscale assesses the impact of dizziness on daily activities such as walking, shopping, working, and participating in social activities. The emotional subscale explores the emotional consequences of dizziness, including

feelings of anxiety, frustration, and depression. The physical subscale evaluates the physical limitations caused by dizziness, including problems with balance, gait, and general mobility. Each item is scored on a scale of 0 to 4, with 0 representing "no," 2 representing "sometimes," and 4 representing "yes." The scores are then summed to give a total DHI score ranging from 0 to 100, with higher scores indicating a greater perceived handicap. The DHI's strength lies in its ability to capture the multifaceted nature of dizziness's impact. It goes beyond merely assessing the severity of physical symptoms and delves into the emotional and social consequences of living with dizziness. This comprehensive approach makes the DHI a valuable tool for clinicians and researchers alike. The DHI aids in diagnosing the severity of dizziness and its impact on a patient's life. It helps guide treatment decisions and tailor interventions to address specific needs. The DHI allows clinicians to track a patient's progress over time and evaluate the effectiveness of treatment. The DHI serves as a reliable and valid outcome measure in clinical trials evaluating interventions for dizziness. It allows for comparisons between different treatment approaches and populations. The DHI contributes to a deeper understanding of the burden of dizziness and its impact on various aspects of life. In this study, the DHI played a central role in demonstrating the effectiveness of VR in improving the quality of life for individuals with BPPV. The significant reduction in DHI scores in the VR group, compared to the SMC group, highlights the profound impact of this intervention. CRM, a key component of VR, effectively repositions the displaced otoconia, leading to a reduction in vertigo frequency and intensity. This directly translates to improved functional abilities and reduced emotional distress, reflected in lower DHI scores. Vestibular exercises promote central nervous system adaptation, enhancing the brain's ability to process and interpret vestibular signals. This leads to improved balance control, reduced dizziness, and increased confidence in performing daily activities, further contributing to lower DHI scores. The individualized nature of the VR program allows therapists to tailor exercises to each participant's specific needs and limitations. This ensures that the exercises are challenging yet achievable, promoting gradual adaptation and maximizing functional gains, ultimately reflected in improved DHI scores. The DHI serves as a powerful tool for assessing the effectiveness of interventions for dizziness. In this study, it eloquently captured the positive impact of VR on the lives of individuals with BPPV, demonstrating its ability to reduce the burden of dizziness and improve overall quality of life. The DHI's comprehensive assessment of functional, emotional, and physical aspects of dizziness makes it an invaluable tool for clinicians and researchers striving to understand and manage this prevalent and often debilitating condition.[11-13]

Vertigo, the hallmark of Benign Paroxysmal Positional Vertigo (BPPV), is more than just a fleeting sensation of dizziness. It's a disruptive force that can significantly impede daily life, causing distress, limiting activities, and even leading to social isolation. Understanding the nuances of vertigo frequency and intensity is crucial in appreciating the true impact of BPPV and the effectiveness of interventions like vestibular rehabilitation (VR). Vertigo frequency refers to the number of vertigo episodes experienced within a given timeframe. These episodes, characterized by a spinning sensation, can range from infrequent occurrences to multiple attacks per day, significantly impacting an individual's ability to function. Vertigo intensity, on the other hand, describes the subjective severity of these episodes. While some individuals may experience mild dizziness, others may endure intense spinning sensations that can be debilitating, often accompanied by nausea, vomiting, and a sense of overwhelming imbalance. Tracking vertigo frequency and intensity provides valuable insights into the progression of BPPV and the effectiveness of interventions. Frequent and intense vertigo episodes signify a more severe manifestation of BPPV, potentially requiring more aggressive management. Changes in vertigo frequency and intensity serve as indicators of treatment effectiveness, helping to guide adjustments in the therapeutic approach. Monitoring these parameters can help predict the likelihood of recurrence and guide long-term management strategies. Tracking vertigo frequency and intensity

provides a window into the patient's subjective experience, allowing for a more personalized and empathetic approach to care. In this study, participants were asked to maintain a Vertigo Diary, a simple yet powerful tool for capturing the day-to-day experience of BPPV. This diary allowed individuals to document each vertigo episode, noting its timing, triggers, and severity. The Vertigo Diary provided a detailed picture of symptom evolution over time, revealing patterns and trends that may have otherwise gone unnoticed. This granular data allowed for a more nuanced understanding of the impact of BPPV and the effectiveness of VR in mitigating its effects. The study's findings highlight the efficacy of VR in not only resolving the immediate episode of BPPV but also in preventing recurrences. The VR group consistently demonstrated a more pronounced reduction in both frequency and intensity of vertigo compared to the SMC group. CRM, a cornerstone of VR, directly addresses the underlying cause of BPPV by repositioning the displaced otoconia. This leads to a rapid resolution of vertigo symptoms and reduces the likelihood of future episodes. Vestibular exercises promote central nervous system adaptation, enhancing the brain's ability to suppress abnormal vestibular signals and maintain balance. This reduces the sensitivity to triggering movements and contributes to long-term stability. By actively participating in their recovery through VR, individuals gain a sense of control over their condition. This can reduce anxiety and fear associated with vertigo attacks, further contributing to a reduction in symptom frequency and intensity. The impact of VR extends beyond mere symptom reduction. By effectively managing vertigo frequency and intensity, VR enables individuals to regain confidence in their ability to navigate their environment, participate in social activities, and live a more fulfilling life. The unpredictable and disruptive nature of vertigo attacks can lead to a fear of falling, social isolation, and a diminished sense of well-being. VR, by mitigating these challenges, empowers individuals to reclaim their lives, reducing anxiety and promoting a return to normalcy. Vertigo frequency and intensity are critical parameters in understanding and managing BPPV. This study underscores the effectiveness of VR in not only reducing these symptoms but also in enhancing the overall quality of life for individuals with this condition. By incorporating VR into the management of BPPV, healthcare providers can offer patients a comprehensive approach that addresses both the physical and emotional challenges of this debilitating condition.[14-16]

Functional mobility, the ability to move freely and purposefully in one's environment, is fundamental to independent living and overall well-being. In the context of vestibular disorders like Benign Paroxysmal Positional Vertigo (BPPV), functional mobility can be significantly compromised, impacting an individual's ability to perform daily tasks, participate in social activities, and maintain their independence. The Timed Up and Go (TUG) test, a simple yet powerful assessment tool, provides a window into an individual's functional mobility. In this study, the TUG test played a crucial role in demonstrating the effectiveness of vestibular rehabilitation (VR) in enhancing functional mobility and reducing fall risk in individuals with BPPV. The TUG test, developed in 1991 by Podsiadlo and Richardson, is a widely used and validated measure of basic functional mobility. Rise from a standard chair evaluates lower extremity strength, balance, and coordination. Walking 3 meters assesses gait speed, stride length, and stability. Turn around evaluates turning ability and postural control. Walking back to the chair provides a second assessment of gait parameters. Sit down evaluates the ability to safely and efficiently return to a seated position. The TUG test is typically administered in a clinical setting using a standardized protocol. The individual is instructed to rise from a standard armchair, walk 3 meters at a comfortable pace, turn around, walk back to the chair, and sit down. The time taken to complete the entire sequence is recorded in seconds. Longer TUG test times are associated with an increased risk of falls, particularly in older adults. Changes in TUG test performance over time can reflect the progression of a disease or the effectiveness of interventions. The TUG test serves as a sensitive outcome measure in clinical trials evaluating interventions aimed at improving functional mobility.

TUG test results can help guide rehabilitation programs, tailoring exercises to address specific areas of weakness or impairment. In this study, the TUG test revealed further evidence of the benefits of VR in enhancing functional mobility for individuals with BPPV. The VR group consistently demonstrated shorter TUG test times compared to the SMC group, indicating a greater improvement in functional mobility. VR programs incorporate a variety of exercises that specifically challenge balance and coordination. These exercises promote postural stability, enhance gait efficiency, and improve the integration of vestibular, visual, and proprioceptive information, leading to better TUG test performance. By addressing the underlying vestibular dysfunction through CRM and vestibular exercises, VR enhances balance control, a critical component of functional mobility. Improved balance translates to greater stability during standing, walking, and turning, contributing to faster and more efficient TUG test performance. As individuals with BPPV experience improvements in their balance and dizziness through VR, their confidence in their ability to move safely increases. This increased confidence can lead to more efficient and fluid movements, reflected in improved TUG test times. The enhanced balance control and improved functional mobility achieved through VR translate to a reduced risk of falls. This is particularly important for older adults with BPPV, who are more susceptible to falls and their potentially devastating consequences. The TUG test, with its simplicity and ease of administration, serves as a powerful tool for assessing functional mobility and fall risk. In this study, it effectively captured the positive impact of VR on the functional abilities of individuals with BPPV. By incorporating the TUG test into clinical practice and research, healthcare providers can gain valuable insights into their patient's functional status and tailor interventions to promote mobility, independence, and safety.[17,18]

This study, demonstrating the efficacy of vestibular rehabilitation (VR) in the treatment of Benign Paroxysmal Positional Vertigo (BPPV), carries profound implications for the Brazilian healthcare landscape. While the findings resonate with the global body of evidence supporting VR, their relevance to the Brazilian context is particularly significant, potentially influencing healthcare policy, resource allocation, and ultimately, the lives of countless individuals affected by this prevalent condition. BPPV, while a common vestibular disorder worldwide, presents a unique challenge in Brazil. The country's large and diverse population, coupled with varying levels of healthcare access and socioeconomic disparities, creates a complex landscape for managing this condition. While precise epidemiological data for BPPV in Brazil is limited, studies suggest a prevalence comparable to global estimates, affecting approximately 2.4% of the population at some point in their lives. This translates to millions of Brazilians potentially experiencing the debilitating effects of BPPV, including vertigo, dizziness, imbalance, and falls. The impact of BPPV extends beyond physical symptoms, affecting emotional well-being, social participation, and economic productivity. Individuals with BPPV often experience anxiety, fear of falling, and limitations in their ability to work and engage in social activities. This study provides robust evidence supporting the implementation and integration of VR into the Brazilian healthcare system. This study clearly demonstrates that VR leads to significant improvements in dizziness-related handicap, vertigo symptoms, and functional mobility compared to standard medical care alone. By incorporating VR into clinical practice, Brazilian healthcare providers can offer their patients the best possible chance of achieving a complete and lasting recovery from BPPV. BPPV imposes a significant economic burden on the healthcare system due to diagnostic tests, medications, and emergency room visits for falls. VR, by effectively managing BPPV and reducing fall risk, has the potential to reduce these costs, freeing up resources for other healthcare needs. VR empowers individuals with BPPV to regain control over their lives. By reducing dizziness, improving balance, and increasing confidence, VR facilitates a return to normal activities, social participation, and overall well-being. VR can be delivered in various settings, including hospitals, clinics, and even patients' homes, potentially increasing access to care for individuals in

underserved communities. This can contribute to reducing health disparities and promoting equity in healthcare access. The findings of this study provide a compelling case for integrating VR into the Brazilian healthcare system. Increase awareness among healthcare professionals and the public about the benefits of VR for BPPV. This can be achieved through educational campaigns, professional development programs, and dissemination of research findings. Develop evidence-based clinical guidelines for the assessment and management of BPPV, incorporating VR as a recommended treatment option. These guidelines should be widely disseminated and adopted by healthcare providers across Brazil. Invest in training programs for healthcare professionals, including physiotherapists, occupational therapists, and physicians, to equip them with the knowledge and skills to deliver high-quality VR services. Increase the availability of specialized VR services across Brazil, particularly in underserved areas. This may involve establishing dedicated VR clinics, integrating VR into existing healthcare facilities, and utilizing telehealth technologies to reach remote populations. Encourage further research on VR for BPPV in Brazil, including studies evaluating long-term outcomes, cost-effectiveness, and optimal treatment protocols for different populations.[19,20]

5. Conclusion

This randomized controlled trial provides compelling evidence for the effectiveness of vestibular rehabilitation (VR) in the treatment of Benign Paroxysmal Positional Vertigo (BPPV) in the Brazilian population. VR, incorporating both canalith repositioning maneuvers and vestibular exercises, resulted in significant improvements across a range of outcome measures, including dizziness-related handicap, vertigo frequency and intensity, and functional mobility, compared to standard medical care alone. These findings underscore the importance of integrating VR into the management of BPPV in Brazil to optimize patient outcomes and enhance their quality of life. By addressing the underlying vestibular dysfunction and promoting central nervous system adaptation, VR empowers individuals to regain control over their daily activities, reduce the limitations imposed by BPPV, and return to a more fulfilling life. Further research is warranted to explore long-term outcomes, cost-effectiveness, and optimal VR protocols for diverse populations within Brazil, ultimately contributing to a more comprehensive and accessible approach to BPPV management throughout the country.

6. References

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